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On Debt Maturities of Firms and Refinancing Risk:

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Abstract

This paper investigates the research question of whether the previously identified factors affect debt maturity choices of the short maturity firms in the same way as the long maturity firms. We find great disparities in the effects of conventional factors across the debt maturity distribution, especially for firms present at the lower and the upper percentiles. This pattern can be explained by the refinancing risk channel. Constrained firms who are heavily reliant on short-term debts find refinancing risk so binding that they fail to respond readily to the conventional financial frictions. In a way to alleviate refinancing risk, relatively flexible firms with large cash reserves are able to borrow at the short-end of the debt maturity spectrum. Conversely, flexible firms who are greatly reliant on long-term debts have minor refinancing pressure, hence would display more interest in gaining cost advantage from short-term public credit programs. Furthermore, we discern that the disparities between debt maturity and the common debt maturity factors are substantial for firms who have access to public credits. The pattern is accentuated if we consider the upper and lower tails of the debt maturity distribution. Note that this paper provides a novel perspective of examining heterogeneous effects of conventional determinants over the debt maturity range and drawing particular implications in the extreme cases.

Keywords: Debt maturity; extreme cases; effect disparity; conditional quantile regression

JEL Classification: G3

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1. Introduction

Recent research documents a downward trend in debt maturities of U.S. firms over the last three decades (Custódio et al. (2013)). Notably, we show that one out of ten U.S. non-financial non-utility firms during the period 1986-2010 adopts extremely short debt maturity policies, with their assets totally financed by short-term debt maturing in one year.

The employment of short-term debt is however not costless. Reliance on short-term debt subjects a firm to higher rollover cost when the firm suffers from temporary business downturn or if interest rate increases. In the case of a credit crunch, excessively short debt maturity intensifies refinancing risk, distorts investment incentives, increases information asymmetry premium, and can even lead to early liquidations (see e.g., Almeida et al. (2009), Duchin et al. (2010), Gopalan et al. (2010), He and Xiong (2010b), and Diamond and He (2014)). The meltdown of Bear Stearns and Lehman Brothers are two typical examples.

Excessively long debt maturity can also impose adverse outcomes. In particular, agency theories advocate that long-term debt induce severe debt overhang. For firms with valuable investment opportunities, long-term debt over-hang at the moment of exercising growth options creates incentives for firms to forgo profitable projects, for otherwise the future benefits of growth options go to the creditors (Myers (1977)). Besides, long debt maturity inclines firms to take on risky projects at the cost of creditors. To compensate for the potential loss from this risk-shifting behavior, creditors request ex ante a higher rate of interest, that is, the cost of "asset substitution" (Barnea et al. (1980) and Leland and Toft (1996)).

Then why firms continue to use excessively short-maturity debt even if it exposes them to high refinancing risk? Analogously, why do some firms rely heavily on long-term debt if it leaves them vulnerable to high agency costs? The explanation can be twofold.

On the one hand, debt maturity choice of a firm may be passive rather than active, especially for those employing extreme debt maturity policies. Custódio et al. (2013) own the recent debt maturity shortening to the booming new listings in the 1980s and the 1990s, representing a group of small firms suffering from high information asymmetry. Based on an equilibrium model for the effect of bank runs (that is, the dynamic coordination among multiple creditors concerning the decisions of debt rollovers and liquidations), Brunnermeier and Oehmke (2013) derive that short debt maturity is a result of maturity rat race among multiple creditors. They further come up with a conclusion that the derived short debt maturity is actually inefficient.

On the other hand, to make debt maturity decisions, firms may be concerned only with the most relevant friction(s). A recent literature review of Graham and Leary (2011) underlines the non-monotonic effects of conventional financial structure determinants. “A given market friction may be a first-order concern for some type of firms, but of little relevance to others”, as Graham and Leary (2011) contend. Firms that are heavily reliant on short-term debts are likely to have more complications. Especially, it is likely that the refinancing risk outweigh or/and intensify the other debt maturity related risks in short debt maturity extremes. Long debt maturity firms can be considered as the opposite to short debt maturity firms in terms of refinancing risk exposure. Intuitively, they shall show less concern for refinancing risk. Allowing for the low refinancing needs, they shall show stronger incentives of issuing short-term debts to confront agency dilemma or to borrow cheaper through commercial paper program or when short-term interest rates are low relative to long-term rates.

Above all, it implies that the effects of conventional debt maturity determinates are non-monotonic across the debt maturity spectrum. Distinct risk structures are likely to be embedded in the extreme cases, with the short extreme case more related to refinancing risk and the long extreme case more related to incentive provisions. Existing studies that have estimated the average (mean) effects of debt maturity factors, combining inherently the magnitudes of effects upon various parts of the debt maturity distribution, may miss important causal impacts. As an example, researchers usually model the average effect of growth options as a negative function of debt maturity. If agency problems are more prevalent than refinancing issues, there is a reason to believe that the negative effect of growth option at the lower debt maturity percentiles shall be substantially higher than on average or at median. Yet, it could also be the case that the negative effect of growth option is attenuated in the lower part of the debt maturity distribution if the refinancing cost dominate over the agency cost at the lower percentiles, most probably for constrained firms. Truly, Leland and Toft (1996) infer that firms with more growth opportunities do not necessarily employ short term debt, since they have not only greater operating risk but also higher bankruptcy costs in most cases.

Taken together, we ask *“do the previously identified factors affect debt maturity choices of the short maturity firms in the same way as the long maturity firms?”* To the best of our knowledge, this is the first attempt ever made to address the heterogeneous effects of debt maturity determinants, especially from the perspective of extreme cases.

To address this question, we adopt the conditional quantile regression, modeling the conditional quantiles of debt maturity with a standard set of previously identified factors that are believed influential to debt maturity decisions. To correct the potential bias due to correlated residuals across firms, we follow Machado et al. (2013) to calculate asymptotically valid standard errors under heteroscedasticity and intra-firm correlation. Confining our attention to the lower and the upper tails of the distribution, we show that the pre-documented factors do influence firms' debt maturity decisions on the whole, whereas the relations depend fundamentally on debt maturity levels and firms at the top and the bottom of the distribution exhibit distinctive patterns.

Particularly, more prominent effect heterogeneities are observed in debt maturity extremes for conventionally investigated determinants, such as firm size, asset maturity, leverage ratio and growth options. For example, we find that firms present at the short and the long end of the maturity spectrum slow down their paces in employing long-term debts when growing in size, lengthening in asset maturity and taking on more debts. The negative effects of growth option and short-term credit access on debt maturity are found on average and at median. However, the magnitudes of the effect are higher in the upper side of the conditional debt maturity distribution. This pattern can be explained by the refinancing risk channel. Specifically, refinancing risk in short debt maturity extremes can be so binding that firms may fail to take timely actions in response to relevant frictions. On the other hand, firms who have debts maturing in the far future have low refinancing need and therefore may not treat refinancing risk seriously. Instead, other concerns may take place, for instance, about borrowing cheaper.

Additionally, the effects of certain factors even change signs as the quantile increases. Age plays a positive role at the lower debt maturity quantiles but a negative role at the upper quantiles. For financially flexible firms, asset volatility is negatively related to debt maturity upon the most parts of the conditional debt maturity distribution while shows positive signs at the lowest quantile, perhaps to prevent from early liquidations. Moreover, our evidence corroborates Harford et al. (2014) who maintain that large cash reserves enable firms to utilize short-term debt through its role of reducing refinancing risk. Specifically, significantly negative correlation between cash holdings and debt maturity is observed at the lower conditional percentiles. We further show that the pattern is reversed at the long end of the maturity spectrum. Firms shorten debt maturity to a greater extent if they are older; have access to short-term public debt market and when short-term debt is cheaper relative to long-term debt. These results support well our intuition concerning the vital (secondary) role of refinancing risk in short (long) debt maturity extremes.

A further investigation reveals the role of credit access in moderating the above pattern. Firms with sufficient credit access behave very different from firms with limited credit access, i.e. those who are heavily reliant on bank loans. In particular, the previously found effect disparities are accentuated for firms with public credit access. Firms with high market-to-book and future abnormal earnings have substantially shorter debt maturities in the lower tail than at median and in the other parts of the conditional distribution. This is also true when we consider a group of highly leveraged firms. By sharp contrast, high market-to-book firms who borrow heavily show longer debt maturities in the higher tail. These results suggest that refinancing risk for firms with flexible credit access is not as binding as for those with limited access, even in the short extremes. Cash plays a negative role at the left tail of the distribution in the forgoing analysis. Nevertheless, this evidence reverses when we consider a group of firms with high leverage ratios. In this case, it indicates the dominance of refinancing risk which could not be alleviated by reserving cash. Note that these results fit well into the line of literature which emphasizes the significance of credit access in influencing firms' financial decisions (see e.g., Faulkender and Petersen (2006), Rauh and Sufi (2010), and Sufi (2007, 2009)).

Overall, our findings are robust after considering the endogeneity between leverage and debt maturity, firm fixed effects, alternative measures for debt maturity and conventional determinants, and remain reliable after including non-US incorporated firms and American Depositary Receipt.

The remainder proceeds as follows. Section 2 reviews the related literature. Section 3 defines the variables of interest and develops the empirical model. Section 4 describes the data. Section 5 presents empirical results on the effects of conventional factors across the debt maturity distribution. Section 6 addresses the role of credit access in moderating the effects of conventional factors across the debt maturity distribution. Section 7 provides robustness checks. Section 8 concludes.

2. Related Literature

2.1. Factors influencing debt maturity decisions of firms

On the basis of the different theoretical predictions, researchers have investigated a set of factors presumably influencing corporate debt maturity choices. Generally, the literature predicts positive signs on firm size, age, leverage, asset maturity, long-term public credit access, and negative signs on growth option, future abnormal earnings, asset volatility, short-term public credit access, cash holdings and the term structure of interest rate[1].

Myers (1977) argues that with a long-term debt over-hang at the moment of exercising growth options, firms possibly forgo profitable projects, for otherwise the future benefits of growth options will at least go partly to the creditors. To mitigate this underinvestment problem, firms shall match the maturities of their assets and debts or finance the assets-in-place with debts maturing before the growth options will be exercised. Big firms have relatively low business risk and are less likely to suffer temporary losses. As they are considered by creditors as less risky, they are able to employ more long-term debts. Reputable old firms with close firm-bank ties are less likely to be severely affected by asset substitution. They are thus more capable of obtaining long-term loans.

Under severe information asymmetry, firms with future abnormal earnings would choose to issue short-term debt in the interest of signaling their prospects (see Flannery (1986), Kale and Noe (1990)). On the other hand, overloading of debt burdens brings firms to favor long-term debts for the sake of hedging against liquidity risk (Diamond (1991), Morris (1992), Leland and Toft (1996) and Jun and Jen (2003)). Low asset volatility encourages creditors to lend more and longer (Kane et al. (1985) and DeMarzo and Sannikov (2006)). For a firm with great volatility, a succession of short-term lendings helps creditors to evaluate fairly the firm's creditworthiness.

Faulkender and Petersen (2006) and Sufi (2007, 2009) highlight the importance of debt fund availability to financing decisions. They maintain that there is a tendency for firms with access to the public credit market to use more public debts. And due to the fact that the maturities of public debts are generally longer than those of bank loans, debts issued by firms with access to long-term public credit have relatively longer maturities than those without access. Some concern the prevalence of commercial paper, a low-cost debt device alternative to bank line of

[1] Note that we do not exhaust the factors investigated in the existing studies. Instead, we discuss the mainstreams.

credit. The low-cost feature makes it particularly preferable for firms with great financial flexibility and little concerns for refinancing risk. All else equal, firms with commercial paper programs, hence short-term public credit access, would have an inclination towards short-term debts.

Harford et al. (2014) establish that refinancing risk induced by debt rollover can be mitigated by holding large cash reserves. Particularly, they find that the marginal value of cash is higher for short debt maturity users. When debt market deteriorates, firms are able to pay down maturing debts with reserved cash without tapping capital markets. In this regard, cash holdings serve as a hedge device against refinancing risk.

Market conditions models establish that for the purpose of seizing opportunity windows of favorable financing conditions, firms issue short-term debts "when short-term interest rates are low compared to long-term interest rates" and "when waiting for long-term market interest rates to decline", rationally or not.

Empirically, all these propositions have gained some support, however great inconsistency has been detected from one paper to another. Notably, researchers disagree over basis facts. Two of the most influential papers, Barclay and Smith (1995) and Guedes and Opler (1996), provide evidence that U.S. firms attempt to mitigate underinvestment problems by using short-term debts. Nevertheless, Stohs and Mauer (1996) report noisy results after adopting a weighted average measure for debt maturity. Evidence on information signaling is also puzzling. Mitchell (1991) demonstrates that firms with profitable projects issue short term-to-maturity bonds when confronted with severe information asymmetry problems between shareholders and creditors. Yet, Barclay and Smith (1995), Stohs and Mauer (1996) and Guedes and Opler (1996) find either statistically insignificant or economically negligible effects. The evidence of the liquidity risk model is less contradictory, but still the literature shows slight inconformity. Mitchell (1993) finds that firms with higher bond ratings are more likely to issue debts with short maturities. In contrast, Guedes and Opler (1996) show that firms with investment-grade ratings issue debts with both short and long maturities while firms with speculative-grade ratings issue medium-term debts. The empirical results on tax models are even conflicting. The coefficients on the term structure of interest rates are reported by Barclay and Smith (1995) and Stohs and Mauer (1996) in the wrong direction (negative). Guedes and Opler (1996) find no effect of taxation on debt maturity decisions of firms. The empirical results on the effect of cash are also inconclusive. Specifically, the evidence in Harford et al. (2014) confirms the negative role of cash holdings in debt maturity, whereas Custódio et al. (2013) and Brick and Liao (2013) find positive relationships between the two. Table I defines a summary of the main theoretical and empirical findings on debt maturity determinants.

[Insert Table I about here]

2.2. Extreme debt maturity and refinancing risk

Recent research documents an important debt maturity shortening phenomenon. Custódio et al. (2013) address the question of why U.S. firms are using more short-term debts and attribute the downward trend to the booming of small size firms with high information asymmetry. Sufi (2007) turns to the supply-side effect. He finds that the shortening of debt maturities is due to the growth of the syndicated loan[2] market. The arrangement of a syndicated debt shares the risk across multiple creditors, leading to a shorter maturity. Brunnermeier and Oehmke (2013) argue that a borrower who cannot commit to an aggregate maturity structure has an incentive to shorten the maturity of an individual creditor's loan for it dilutes the value of the remaining creditors. Therefore, in equilibrium, all the creditors shorten maturity dates of their contacts.

Nonetheless, short-term debt is not a free lunch. A firm who finances a great portion of its assets with short-term debts is confronted with high refinancing risk (e.g., Diamond (1991, 1993), Diamond and Rajan (2001), Diamond and He (2014)). Due to high rollover frequency, the firm is likely to find itself trying to refinancing at an inappropriate time when interest rates are high. If the situation worsens to the extent that the firm is unable to pay off the maturing debts, it might have to sell off its assets at cut-throat prices. In the worse-case scenario, creditors underestimate the fundamental value of the firm and choose to liquidate it early. Indeed, Brunnermeier and Oehmke (2013) argue that the extremely short debt maturity driven by the "maturity rate race" is actually costly and inefficient.

Diamond (1991) is the first to address the refinancing issue considering its effect on debt maturity choices of firms. Expanding Flannery (1986)'s asymmetric information model, he considers the situation that creditors refuse to roll over maturing short-term debts for high-risk firms. Naturally, high-risk firms opt for long-term debt to prevent from refinancing debts in hard times. Yet, for extremely high-risk firms, they are screened out of the long-term debt

[2] Syndicated debt, by definition, is issued by a syndicate of investors which can include multiple banks or/and financial institutions.

market due to excessive asset substitution risk. Altogether, he predicts a non-monotonic relation between debt maturity and credit risk. In a dynamic global-games setting, He and Xiong (2012a) model a firm with time-varying fundamental, who finances its long-term assets by rolling over short-term debts with several creditors. The maturity dates of the firms' short-term debt spread out across time. The creditors face a risk that 1) the firm fails to commit to the subsequent debt contract; 2) the future creditors refuse to roll over the maturing debts. In closed form, they derive a unique safety threshold considering dynamic coordination among creditors. They show that as long as the current fundamental of the firm is above the threshold, each creditor chooses to roll over the maturing debts. Further, He and Xiong (2012b) emphasize the impact of short debt maturity in intensifying rollover risk in credit crunch. They find that the conflict of interest between credit holders and equity holders deepens in crisis periods, forcing firms into early liquidations. To the extent that the losses firms suffer from rolling over maturing debts are absorbed by equity holders and not by debt holders, firms opt for early default.

An alternative literature argues that rolling over large amount of short-term debts at the time when a firm is suffering temporary business downturns or/and facing high interest rates can also distort the firm's investment incentives. Different from classical agency models which predict long-term debt overhang (e.g. Myers (1977)), Diamond and He (2014) contend that short-term debt may impose even stronger overhang than long-term debt does. Particularly, Diamond and He (2014) criticize that treating short-term debt as riskless is the fatal defect in previous research.

Empirically, Almeida et al. (2009) and Duchin et al. (2010) provide evidence that firms with an overload of debts maturing at the onset of the 2007/2008 crisis are more likely to forgo valuable investment opportunities. Hu (2010) finds significantly higher credit spreads for these firms. Acharya et al. (2011) show that high rollover frequency results in diminishing collateral value and debt capacity.

To sum up, the existing literature suggests inherent risk embedded in extreme debt maturity cases, especially on the short end of the spectrum. Using short-term debt mitigates incentive provisions. However, excessive reliance on short-term debt exacerbates liquidity risk. Long-term debt alleviates refinancing risk, but excessive reliance on long-term debt can result in severe debt overhang.

2.3. Heterogeneous Effects of Debt Maturity Determinants

The implication of the extreme debt maturity can be projected onto the contingency of financial frictions. As Graham and Leary (2011) suggest, a specific friction can be a primary concern under certain circumstance but have no importance in other contexts. To put it simply, debt maturity decisions depend on the financial friction(s) firms are most concerned about.

Firms who finance a large portion of their assets with short-term debts should be much more concerned about the liquidity issue. As soon as they are unconstrained, they shall show more interest in matching the maturities of assets and liabilities. In the case that debt is the main source of funds, they would naturally incline toward long-term debt, given the probability of insolvency (Geanakoplos (2010)). When their assets become volatile, they would negotiate with their creditors to obtain long-term debts to hedge against early liquidations. Those with long-term credit access would naturally have a strong tendency for long-term debt. Accounting for the high asset substitution risk caused by short debt maturity, big firms will be valued by creditors to a greater degree as they are less likely to encounter business hazards. Alternatively, creditors would be more ready to offer better terms and conditions (e.g. longer loan maturity) for old firms with close bank relationships. Considering high refinancing risk, the signaling incentive shall play a smaller role at the short end of the debt maturity distribution than in the long end. The inverse relationship between cash holdings and debt maturity shall be more pronounced for firms with high refinancing risk, that is, firms who have a large portion of debts maturing in the near future.

In an analogous manner, firms present at the higher debt maturity quantiles shall care less about refinancing needs but are more likely to come across severe debt overhang. As a consequence, they shall show more concern for agency dilemma. Besides, allowing for the low refinancing frequency and therefore low liquidity risk exposures, they shall have stronger incentives of issuing short-term debts in the interest of borrowing cheaper, e.g. through commercial paper program, lower short-term interest rates relative to long-term interest rates or waiting for the long-term interest rates to decline. Furthermore, with trivial rollover risk, the negative relation between cash holdings and debt maturity is expected to weaken, disappear or even reverse.

It indicates that the direct effects of firm age, size, asset maturity, leverage and long-term public credit access as predicted by classical models shall decrease along the debt maturity spectrum, while the inverse impacts of growth option, asset volatility, future abnormal earnings, term structure, and short-term public credit access shall increase along with the debt maturity level.

Nonetheless, it worth noting that these expected relationships at both tails of the debt maturity distribution would only occur when firms are not constrained and concerned about the relevant frictions as discuss above. In other words, the above pattern is only expected to take place in an active manner. Be that as it may, this just shows the contingent role of financial frictions and thus the heterogeneity in their effects on debt maturity.

On the basis of the above, we generally hypothesize that the relevance of the conventional financial frictions varies with debt maturity levels. Liquidity problems are expected to be more binding in short debt maturities while become secondary in long debt maturities.

3. Methodology

3.1. Variables

3.1.1. Debt maturity structure

In the literature, two major approaches are employed to measure the maturity structure of debt: the balance sheet approach and the incremental approach. The balance sheet approach, which is most commonly used, defines maturity structure of a firm's overall debt as either the percentage of liabilities with certain maturities (e.g., Barclay and Smith (1995), Barclay et al. (2003), Johnson (2003), Billet et al. (2007)) or the weighted average maturity (e.g., Stohs and Mauer (1996), Saretto and Tookes (2011), Chen et al. (2012)). The incremental approach measures debt maturity as the term-to-maturity of new debt issues (e.g., Mitchell (1991), Guedes and Opler (1996), Berger et al. (2005)). One of the main advantages of this approach is to provide the possibility of examining the interplays between the maturity structure and the other features of debt contracts, such as call and put provisions, sinking funds, redemption schedules and debt covenants (e.g., Mitchell (1991), Guedes and Opler (1996), Billet et al. (2007) and Barry et al. (2008)). However, one should interpret the resulting findings with caution because one-shot debt issuance does not necessarily reflect a firm's unalloyed financing intent. Focusing on a specific type of debt is obviously inadequate considering that firms usually use a combination of both public and private debts. As a proof, Billett et al. (2007) find that a firm's total debts reported in COMPUSTAT exceeds its aggregate debt issues in Fixed Investment Securities Database (FISD). Similarly, Rauh and Sufi (2010) show that a majority of firms in their sample use bank loans as well as non-bank debts. Besides, concrete term-to-maturity decisions are, in most cases, less relevant for firms in comparison with short- versus long-term debt choices. For instance, once a firm has decided to enter the long-term bond market, it may be indifferent between issuing a 10-year bond or a 15-year bond. We thereby ground our research on the balance sheet approach. Prior studies on debt maturity determinants define long-term debts as the financial obligations that are to come due in more than one year (e.g., Scherr and Hulburt (2001), Antoniou et al. (2006) and Fan et al. (2012)), three years (e.g., Barclay and Smith (1995), Barclay et al. (2003), Johnson (2003), Datta et al. (2005), and Billet et al. (2007)) or five years (e.g., Ozkan (2000) and Datta et al. (2005)). Measures of this type are, however, suspicious to bias as debts with maturities below and over the definition threshold are treated as homogeneous, which is not the real case. To address this issue, we construct a value weighted debt maturity structure. Precisely, debt maturity is defined as the value weighted average life for a firm's total debts, as calculated in formula (1) below.

$$DMAT = \sum_{i=1}^{5} \frac{Debt_i}{Tdebt} \times Duration_i + \frac{(Tdebt - \sum_{i=1}^{5} Debt_i)}{Tdebt} \times Duration_r \qquad (1)$$

Where DMAT represents the value weighted average debt maturity structure of a firm, $Debt_i$ represents the amount of financial debts payable in year i for $i \leq 5$. *Tdebt* refers to the amount of total financial debt, which is calculated as the sum of total long-term debts and debts in current liabilities. Note that we exclude operating and miscellaneous liabilities to measure DMAT.

Duration of a financial asset is defined theoretically as the weighted average length of time until all payment streams generated by the asset are received. It takes into account the elasticity of the bond price to interest rate and identifies the "actual" weighted length of time needed to recover the current cost of the bond (Copeland et al. (2005)). Due to the fact that we work on balance sheet data, we have no sufficient information (e.g., payment schedules) to calculate the real durations of all the debts employed by a firm. But at least we know that the duration of a debt should always be shorter than the time-to-maturity except for zero-coupon bonds. Reasonably, we follow Jun and Jen (2003) and Chen et al. (2012) to assume that the average durations of a firm's debts payable in year 1,2,3,4,5 (denoted by $Debt_1$, $Debt_2$, $Debt_3$, $Debt_4$, $Debt_5$) are 0.5, 1.5, 2.5, 3.5 and 4.5 years respectively, denoted by $Duration_i$ for $i \leq 5$. For the rest of debts, we assign them an average duration of 10 years, denoted by $Duration_r$. This measurement may be less accurate than the term-to-maturity measure. But it is more efficient in describing the overall maturity profile of a firm's debt usage and is much more precise compared to the regularly used long-term debt proportion measure.

3.1.2. Debt maturity factors

We examine a standard set of factors assumably influencing debt maturity choices of firms, including firm size, age, leverage, asset maturity, growth options, future abnormal earnings, asset volatility, credit access, cash holdings and the term structure of interest rate.

Specifically, to remove the effect of over-time growth in stock market, we infer a firm's relative size from Fama and French (2001)'s NYSE percentile. Precisely, we estimate firm size as the percentage of NYSE firms that have the same or smaller market capitalization. Firm's CRSP listing years is used to measure firm age. We calculate book leverage (the ratio of a firm's total debt outstanding to book assets) instead of market leverage, following the argument that market leverage could be spuriously correlated with other explanatory variables, such as growth options (e.g., Rajan and Zingales (1995) and Graham and Harvey (2001), Barclay et al. (2006)). For asset maturity, we follow the formula of Stohs and Mauer (1996) to compute the weighted average maturity of current and long-term assets. To capture the growth options of firms, we resort to two variables: the market-to-book ratio and the R&D ratio. The former is calculated as book value of total assets minus book value of common equity plus market value of common equity, all divided by book value of total assets. The latter is the fraction of a firm's R&D expenses to total book assets. Further, to measure managerial anticipation of a firm's future prospect, we use the firm's future abnormal earnings. We calculate a firm's idiosyncratic volatility, subtracting the industry-level asset volatility (the medium asset volatility of Fama-French 48 industry). We proxy for firms' public credit access with reference to Standard and Poor's domestic long- and short- term issuer credit ratings. Cash holdings of firms are measured as the ratio of cash and short-term investment to total book assets. The term structure of interest rates is calculated as the yield spread on 10-year U.S. T-bond and 3-month U.S. T-bill. All the variables are defined in Table II.

[Insert Table II about here]

3.2. Empirical specification

The general idea of the paper is to reconsider the debt maturity determinants issue by asking whether the previously identified factors, such as underinvestment and liquidity risk affect debt maturity choices of the long maturity users the same way that the short maturity users are affected. To answer this question, we refer ourselves to the quantile regression technique ((hereafter QR)), developed by Koenker and Bassett (1978).

QR addresses the relationships between a response variable Y and a set of covariates X over the whole range of the conditional distribution function of Y. The ability of offering a much more complete picture of the relationship between X and Y sets it apart from the conventional least squares estimation method which simply plots the group means. Specifically, focusing on the central tendency of a response variable's distribution, OLS estimates how the covariates X influence the response variable Y on average. In cases that other quantiles of Y are of interest, OLS is incapacitated while QR becomes desired (Koenker and Bassett (1978)). In this regard, QR suits perfectly our research context.

The economic framework of QR is expressed as follows.

Consider a random variable Y with probability distribution function

$$F\ (y) = P(Y \leq y) \qquad (2)$$

The θ^{th} quantile of Y conditional on the covariates X is defined as

$$Q_\theta(y|x) = \ \inf\{\text{y}: \text{F}\ (y|x) \geq \theta\} \qquad (3)$$

Assuming that the θ^{th} quantile of the conditional distribution of Y is linear in X, then

$$Q_\theta(y|x) = \ \text{x}\beta_\theta \qquad (4)$$

where β_θ is the parameter to be estimated for the θ^{th} quantile ($0 < \theta < 1$).

Errors for quantile θ, denoted as ε_θ are assumed to have

$$Q_\theta(\varepsilon_\theta|x) = 0 \qquad (5)$$

Different from OLS estimation that solves the problem of minimizing a sum of squared residuals, QR solve the problem of minimizing the symmetry (median) or asymmetry (other quantiles) weighted sum of absolute errors as stated below

$$\min \textstyle\sum_{i=1}^{n} \rho_\theta |y_i - x_i\beta_\theta| = \ \min \textstyle\sum_{i=1}^{n} \rho_\theta |\varepsilon\ | \qquad (6)$$

$$\text{where } \rho_\theta(\varepsilon) = \begin{cases} \theta\varepsilon & when\ \varepsilon\ \geq 0 \\ (\theta-1)\varepsilon & when\ \varepsilon < 0 \end{cases} \qquad (7)$$

The QR estimator does not have an explicit expression form but linear programming such as simplex, interior point and smoothing algorithm can solve the problem quite efficiently (see Koenker and Basset (1978)).

There is a growing literature in empirical finance employing QR methods. Most has been dedicated to address the issue of value at risk (Bassett and Chen (2001)). QR methods are surprisingly underdeveloped in capital structure research, despite the fact that great disparity is found in firms' financial structures. For instance, Strebulaev and Yang (2013) underline a phenomenon concerning the presence of a crowd of zero-leverage firms. In terms of debt maturity, Guedes and Opler (1996) have attempted to address the uneven effects of debt maturity determinants. They classify new debt issuance into several maturity categories and next running multinomial logit regressions. Their results show substantial differences relative a baseline group of issues with short maturities. Although their method helps to explore the extreme cases to a certain degree, truncating the dependent variable into subsets treats firms within categories as homogeneous and throws away useful information. As is clearly put by Heckman (1979) and Koenker and Hallock (2001), this type of analysis which is based upon the unconditional distribution in nature would yield a common bias, known as "the sample selection bias".

In an effort to address the question of whether conventionally investigated debt maturity factors influences debt maturity choices of firms the same way across the debt maturity spectrum, we estimate the conditional debt maturity quantile regression at the θ^{th} quantile as follows,

$$Q_\theta\left(DMAT_{i,t} \middle| X_{i,t-1}\right) = \alpha_\theta + \beta_{1\theta} NYP_{i,t-1} + \beta_{2\theta} AGE_{i,t-1} + \beta_{3\theta} LEV_{i,t-1} + \beta_{4\theta} AMAT_{i,t-1} + \beta_{5\theta} MTB_{i,t-1} + \beta_{6\theta} R\&D_{i,t-1} + \beta_{7\theta} ABNEARN_{i,t} + \beta_{8\theta} VOLAT_{i,t-1} + \beta_{9\theta} ACCESS\_L_{i,t-1} + \beta_{10\theta} ACCESS\_S_{i,t-1} + \beta_{11\theta} TERM_{i,t-1} + \beta_{12\theta} CASH_{i,t-1} + \beta_{13\theta} CONSTRAINT_{i,t-1} + \beta_{14\theta} CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta} CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1, \ldots, n \quad t = 1, \ldots, T \tag{8}$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II. We include a dummy variable for financially constrained firms and its interactions with asset volatility and cash holdings, allow for different attitudes of financially constrained and unconstrained firms in response to fundamental volatility and cash policies. Specifically, firms are sorted and categorized into three groups using the 30% and the 70% cutoffs of Altman's Zscore. Firms present in the bottom 30% are identified as financially constrained. All the explanatory variables are lagged one period allowing for delays in firms' financing decisions. The only exception is firms' future abnormal earnings, on the grounds that it proxies for managerial anticipation for future prospect rather than past return.

In light of the properties of datasets (i.i.d./non i.d.d., large/small sample size), standard errors and confidence intervals for the parameter β_θ can be computed using either Koenker or Basset's asymptotic method or bootstrapping method (e.g., Buchindky (1995), Buchindky (1998)). Although instructive, these estimation methods fail to capture the specific features of panel data. The dataset employed in this paper contains observations for the same firm over multiple years. It is therefore possible that the debt maturities of a given firm are correlated across time. In particular, the renowned work of Petersen (2009) brings the attention of empirical finance researchers to the essentiality of properly treating the cross-sectional and the time-series residual dependence related to panel data. Given this specificity, a recent research of Machado et al. (2013) estimates asymptotically valid standard errors under heteroscedasticity and intra-cluster correlation. Following their estimation strategy, we calculate clustered standard errors which are robust to intra-firm correlations.

4. Data

4.1. Sample

Our sample is drawn from CRSP/Compustat Merged Database. Compustat PERMNO-PERMCO-GVKEY link is used to merge CRSP, COMPUSTAT and Rating Data. Market-specific information is acquired from the Federal Reserve Bank of St. Louis database. Similar to other debt maturity studies, we confine our sample to U.S. publicly traded non-financial non-utility firms. Precisely, we exclude firms with primary Standard Industrial Classification codes 6000-6999 (Finance, Insurance and Real Estate) and 4900-4999 (Electric, Gas, and Sanitary Services). To avoid noisy findings due to the existence of non U.S. based firms in the sample, we eliminate firms which are listed on U.S. stock exchanges but incorporate and operate in other countries. In this case, debt maturity decisions of firms can be greatly influenced by the domicile country's institution. Accordingly, American Depositary Receipt (ADR) are eliminated. Our sample period begins in 1986 and ends in 2010.

To concentrate on firms' debt maturity decisions, we discard firm-year observations with zero debt outstanding and observations with incomplete debt maturity information. Further, we remove observations where leverage values are inferior to 0 or superior to 1. Note that quantile regression is robust to extreme points in the response variable rather than in the covariates. We thereby winsorize all the explanatory variables at the 1st and 99th percentiles. The final sample is comprised of 7734 firms with 47161 firm-year observations. The panel is unbalanced and not all firms are present in all of the observation years.

Table III checks the over-time distribution of firms by size. To isolate the effect of the general growth of U.S. stock market and to allow for a year-by-year comparison, we measure the fraction of a firm's market capitalization to the total market value of CRSP US total market index[3]. Firm-year observations are pooled and then sorted into size deciles for the whole period 1986-2010. For a specific size decile and a given sub-period (1986-1989, 1990-1994, 1995-1999, 2000-2004 and 2005-2010), we calculate the percentage of firms to the total number of firms present at the corresponding period.

[Insert Table III about here]

As the table shows, the number of firms has generally increased in the 1990s, and subsequently cut back to nearly the original level in the 2000s. In the periods 1986-1989, 1990-1994 and 1995-1999, 52%, 53% and 56% of firms are smaller than the period median. Yet, by the end of our sample period, only 38% of firms are smaller than the period median. This result confirms the prevalence of small firms in recent decades. As small firms have a natural tendency towards short-term debts, this result corroborates the prior evidence concerning the debt maturity shortening (see Custódio et al. (2013) and Harford et al. (2014)).

4.2. Descriptive statistics

Table IV reports the descriptive statistics of debt maturity structure and firm characteristics measured as of the fiscal year end. To compare with previous studies, we discuss in the first place the proportions of debts with maturities of more than one through five years for our sample firms.

[Insert Table IV about here]

Similar to previous studies (e.g., Billett et al. (2007), Custódio et al. (2013) and Chen et al. (2012)), the average firm of our sample has 72% of total debts maturing in more than one year, 48% of total debts maturing in more than three years, and 31% of total debts maturing

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[3] As a robustness check, we measure Fama and French (2001)'s NYSE percentile. This exercise yields similar results.

in more than five years. For our weighted average debt maturity measure, the mean value is 4.40 years, which is slightly shorter than 4.76 years in Chen et al. (2012). Notice that Chen et al. (2012) impose additional restrictions on the sample selection (e.g., total debt must represent at least 5% of total asset) and cover a longer period of time (from 1974 to 2010). Our results are therefore not directly comparable with theirs in the sense that we are not investigating the identical group of firms. Further, the standard deviation and inter-quartile range suggest substantial cross-sectional variation in debt maturities of U.S. firms. It's worth noting that the 90^{th} percentile of DMAT is roughly 13 times the 10^{th} percentile, indicating the significant debt maturity disparity between firms.

Summary statistics for key firm features show no divergence against previous literature. The only exception is abnormal earnings. Specifically, the average firm in our sample performs relatively badly, with abnormal earnings of -0.03. Other studies, for instance Johnson (2003) and Billett et al. (2007), report positive abnormal earnings. We probe into this issue and find that this is due to the inclusion of the recent financial crisis. Similar evidence of negative abnormal earnings is documented in Custódio et al. (2013) whose sample period contains the financial crisis of 2007/2008[4].

Figure I plots the debt maturity histogram, which reveals overwhelmingly skewed debt maturity distribution for U.S. non-financial non-utility firms. Particularly, extreme values appear on both the left and the right sides of the distribution. In particular, it appears that one out of ten U.S. non-financial non-utility firms during the period 1986-2010 adopt extremely short debt maturity policies, with their assets totally financed by short-term debt maturing in one year.

[Insert Figure I about here]

Figure II exhibits the year-over-year debt maturity changes. The shaded areas represent NBER-dated recessions. In accordance with Barclay and Smith (1995) and Brockman et al. (2010), we observe a gradual decline in both the average and the median debt maturity from 1986 to the early 2000s. The average debt maturity is 4.76 years in 1986 then reaches the bottom of 4.00 in 2000. Thereafter, the average debt maturity rises sharply until it meets another trough in 2009. The mean and median values of debt maturity are very similar in earlier years. However, the difference has been widened since 1989, indicating the

[4] In our robustness analysis, we limit our sample period to 2006. Indeed, the average abnormal earning turns to positive.

appearance of short debt maturity users during that period, most probably new listed small firms. The two nadirs of debt maturity coincide with two famous U.S. economic recessions: the Dot-Com crisis and the recent credit crunch following the subprime mortgage crisis. This over time pattern holds for all the percentiles but the shift downward is more pronounced for the lowest percentile and the shift upward is more prominent for the highest percentile, indicating an increasing polarization. Firms at the bottom 10^{th} percentile, throughout the period except for in 1986, issue debts with average maturities of less than one year while firms at the top 10^{th} percentile issue debts with average maturities of more than eight years.

[Insert Figure II about here]

The examination of extreme cases helps researchers inhibit the over-generalization problem. As suggested above, some firms finance their assets with a great percentage of long-term debts. Others use a high proportion of short-term debts. These extreme cases can be exceptionally informative as they may indicate particular financing strategy formulation. To address this concern, we conduct unconditional decile analysis before turning to quantile regression analyses. Firm-year observations are sorted and equally divided into 10 portfolios based on the weighted average debt maturity of firms. For each debt maturity decile, we report the mean value of each firm-specific variable, as documented in Table V.

[Insert Table V about here]

Several interesting features unfold. First of all, it shows that firms vary greatly in employing debt with different maturities. Average debt maturity ranges from 0.51 years in the lowest decile to 9.32 years in the highest decile. Secondly, by and large, firms in the longer debt maturity deciles are distinct from those in the shorter debt maturity deciles. In general, the former firms are generally larger, less volatile, flexible in obtaining public credit and slower in growth rate. Besides, they have heavier debt load and invest more in long-term assets. The values of market-to-book, R&D and volatility basically decrease along the spectrum and are slightly reversed in the highest decile. Thirdly, large cash reserves are found in both the highest and the lowest debt maturity deciles. It seems that firms with extremely short and long debt maturities reserve more cash in comparison with those lie in between. Although these findings are instructive, they are limited by the fact that they are merely demonstrating unconditional relations. The following section will be confined to examining the conditional relations between debt maturity and the above factors.

5. Do conventional factors affect debt maturity choices the same way along the debt maturity spectrum?

Motivated by investigating the heterogeneous effects of conventional factors over the entire range of debt maturity, Figure III plots the quantile processes for Specification (8). For each of the 16 covariates (including an intercept), we plot the quantile regression estimates as a function of quantile ranging from 0.05 to 0.95, shown as the point wise solid curve. The shaded grey band depicts the conventional 90 percent confidence interval. The OLS estimates are plotted for comparison purpose, shown as the long dashed line. The two surrounding dotted lines denote its confidential band.

[Insert Figure III about here]

Regularities emerge from the OLS results. Specifically, debt maturity is found positively associated with firm size, leverage, asset maturity and long-term public credit access and negatively associated with market-to-book ratio, R&D ratio, future abnormal earnings, short-term public credit access and the term structure of interest rate. By sharp contrast, quantile regression results differ fundamentally from the OLS results in size, significance and even sign of the estimated coefficients.

To be precise, the quantile processes show clear effect disparity across the conditional debt maturity distribution. The effect is accentuated if considering the lower and upper tails of the distribution. The traditional least squares estimation, which inherently combines the sizes of effects along the conditional debt maturity distribution, does a poor job of displaying this range of heterogeneities. For instance, it turns out that highly leveraged large firm with long asset maturity has obvious inclination to borrow at the long end of the debt maturity spectrum although the magnitudes of the estimates are smaller at the tails. Note that the dashed least square confidential intervals pass above the estimates for leverage, size and asset maturity at the lower and upper tails of the distribution, indicating that the least square estimates are captured mainly by the middle parts of the conditional distribution.

Effect enforcement at the long debt maturity end is perceived for certain variables, such as short-term public credit access, future abnormal returns, and term structure of interest rates. Take short-term public access for example. Its quantile process, illustrated in the third panel of the third row, shows how different are the corresponding debt maturities of firms with and without short-term public credit access. Overall, firms with short-term public credit access have shorter debt maturities than their counterparties. But as is clear from the quantile regression results, the disparity is considerably smaller in the left tail of the distribution but much larger in the right tail. It suggests that firms with particularly large long-term debt overhang have strong incentives to cut down long-term debt usage when cheap short-term public credits become accessible.

Researchers, e.g., Shyam-Sunder and Myers (1999), Chen and Zhao (2007), Chang and Dasgupta (2009), have highlighted the mean-reversion process considering the boundary feature of financial structure. Given that the commonly used debt maturity measures, including ours, bear a boundary feature, it is possible that the attenuated effects observed in the tails are driven in part by mechanical mean reversion. Indeed, in the unreported cross-sectional quantile regressions using the time-series mean of each variable by firm[5], the above attenuation pattern on the right tail (the 90^{th} and the 95^{th} quantiles) is flattened.

We next report OLS and quantile regression results for the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantiles, as shown in Table VI. Clustered standard errors by firm are reported. For each covariate, the estimates in the corresponding quantile process can be interpreted as the impact of a one-unit change of the covariate on debt maturity holding other covariates constant. To avoid drawing mistaken inferences due to the mechanical patterns around the boundaries of debt maturity, we interpret our results based two lower quantiles and two upper quantiles: the 10^{th} and 25^{th} quantiles (for short debt maturity), and the 75^{th} and 90^{th} quantiles (for long debt maturity). Then, to check whether the differences of coefficient estimates between quantiles are statistically important, we report in Panel B, Table VI the interquantile regression results.

[Insert Table VI about here]

As is clearly shown in the above table, heterogeneous effects along the distribution of debt maturity unfold. Holding all the other variables constant, debt maturities of firms with long-term public credit access are 1.846 years longer than those of firms without long-term public credit access at the 50^{th} quantile. At the 10^{th} and 90^{th} quantiles, the disparities are 1.468 and 1.355 years respectively. Similar patterns can be observed for leverage, size and asset maturity. There are negative relations between growth option and debt maturity. The size of the relation is larger at the higher quantiles, especially at the 75^{th} quantile. The expected

[5] Although instructive, modeling the mean response may suppress important over-time characteristics. We therefore do not

negative sign for firms' future abnormal returns is found at most quantiles. But again, the effect appears more remarkable at the upper percentiles. Likewise, high term structure of interest rates is prone to shorten the debt maturities of the upper tail firms more than those of the lower tail firms.

Notably, the estimates for age, asset volatility and cash holdings change directions upon different parts of the conditional debt maturity distribution. Note that the confidence interval of the ordinary least squares estimation suggests weak effect of firm age on average. Yet, the quantile regression results exhibit a distinct pattern. Specifically, the slope parameter of age changes from positive (0.004 at the 10^{th} quantile) to negative (-0.005 at the 90^{th} quantile) over the debt maturity distribution. Previous studies, as discussed earlier, argue that firms with large cash holdings are relatively low in refinancing risk and therefore able to use more debts with short maturities. Our results show consistent evidence in the significantly negative estimates for cash at the lower quantiles for firms with strong fundamentals. At the longer debt maturity quantiles, the estimates for cash are positive. Specifically, a one-unite change of cash holdings decreases debt maturity of unconstrained firms by 0.269 years at the 10th percentile of the conditional distribution but increases debt maturity of these firms by 3.409 years at the 90th percentile. The positive estimates for cash at the higher quantiles are mitigated for firms with weak fundamentals but the coefficients are not statistically significant. Generally speaking, asset volatility is negatively related to debt maturity, with the only exception at the 10^{th} quantile for financially unconstrained firms. Note this result coincides with He and Xiong (2012a) who argue that in the interest of hedging against early liquidations, short debt maturity firms with high asset volatility would negotiate with their creditors to obtain long-term debts as long as the value of their assets do not fall below the fundamental threshold. Moreover, we find that in the short-end of the debt maturity distribution, higher asset volatility forces constrained firms to employ even shorter debt maturities, while lead unconstrained firms to adopt higher debt maturities. The former firms are most probably screened out of the long-term debt market while the latter firms have a tendency to take active actions to hedge against refinancing risk. Similarly, cash reserves help unconstrained firms to use more short-term debts at the lower debt maturity quantiles, whereas lean constrained firms towards long-term debts. These results imply distinctly different financing patterns between constrained and unconstrained firms.

The interquantile regression results confirm that the conventional debt maturity factors exert significantly different roles for short and long debt maturity users. The impacts of the included factors vary with the debt maturity spectrum in a significant manner. This pattern of polarization is prominently displayed in the two extremes, especially for age, asset maturity and cash. Age is positively related to debt maturity at the lower percentiles while negatively related to debt maturity at the higher percentiles. Note that the difference in the AGE estimates between the $10^{th}/25^{th}$ and the 50^{th} quantiles is positive (0.004, 0.003) and significantly different from zero. Yet, the difference between the $75^{th}/90^{th}$ and the 50^{th} quantiles is significantly negative (-0.005/-0.006). The effect of asset volatility reverses from positive at the 10^{th} percentile to negative at the higher percentiles for financially flexible firms. The interquantile regressions further confirm that the differences in the effect of asset volatility are significantly positive between the lower and the higher quantiles in the lower half of the debt maturity distribution but is significantly negative (-1.173) for the 75^{th}-50^{th} interquantile. Cash reserves are only inversely associated with debt maturity at the lower quantiles for financially flexible firms. The interquantile coefficients show that the negative effect of cash on debt maturity for these firms is truly more salient at the lower quantiles.

Whether the conventional debt maturity factors have persistent influences over the quantile range? To address this question, we run OLS and Quantile regression at the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantile for annual cross-sections from 1986 to 2010, which generates 25 estimates for each variable and every investigated quantile. Then we investigate how often the estimated coefficients of a covariate are different from zero at the conventional statistical significances (1%, 5% and 10%), in positive or negative signs. The results are displayed in Table VII.

[Insert Table VII about here]

Effect attenuation is again observed on the tails of the debt maturity distribution. For instance, even though the estimated coefficients of leverage and asset maturity have consistent signs at the given quantiles, the statistical significance is marginal at the long extremes. In particular, asset maturity is only effective in 12 out of 25 periods, suggesting that low rollover risk embedded in long debt maturities makes matching maturities of assets and liabilities a low priority for firms. The effects of short-term credit access are negative in most of the periods at the higher quantiles. However, at the lower quantiles, the effects are inconclusive. Precisely, in the lower half of the debt maturity distribution, the estimates for ACCESS_S are negative in certain periods but positive in others. It implies that high rollover risk embedded in short debt maturities leans firms to long-term debts even cheap short-term credit access is available. Note that firms with short-term public credit access usually have very flexible credit access, not only to short-term and but to long-term as well. The quantile effects of firm age, future abnormal earnings and asset volatility show little persistence. This is perhaps due to the time-series nature of the effects of these factors on debt maturity.

Intuitively, this brings us to the question of whether the above evidence is led by the fact that the effects of these factors vary with the business cycle. Shocks in an economy make financial frictions more binding (Almeida et al. (2004), Gomes et al. (2006), Campello and Chen (2010)). During recessions, corporate cash flow drops sharply and public debt market is suppressed. The fundamental threshold of a firm's default probability becomes higher consequently, resulting in higher credit risk and higher cost of information asymmetry (e.g., Korajczyk and Levy (2003), Hackbarth et al. (2006), Levy and Hennessy (2007), and Bhamra et al., (2010)). To investigate whether business cycles moderate the previous findings, we divide firm-year observations into three sets: observations in soft periods, normal periods and hard periods. The classification is made according to the term structure of interest rates, measured as of a firm's fiscal year end. An observation with fiscal-year-end term structure above the 70th percentile is classified as in soft periods and those below the 30th percentile are classified as in hard periods. We then estimate Specification (8), separately for hard and soft periods. The term structure of interest rate is excluded from the quantile regressions.

[Insert Table VIII about here]

Conforming to the previous findings, we find monotonic relationships between debt maturity and its determinants along the debt maturity spectrum in both hard and soft periods, as reported in Table VIII. Firms at the lowest and the highest percentiles exhibit distinctive patterns in attenuated, strengthened and reversed parameter estimates (e.g., AGE, VOLAT, and CASH). The results also confirm the conventional wisdom in that refinancing risk is more binding in hard periods. Firms subjecting to high rollover risk (i.e., those present at the lower percentiles of the debt maturity distribution) place more value to long-term credit access in hard periods relative to soft periods. Soft period results report significantly positive effects for the financial constraint dummy (CONSTRAINT) at the 10th and the 25th quantiles. It turns out that expanded economy inclines firms with high refinancing risk towards borrowing more long-term debts for self-protection purpose. Yet, there is also evidence in support of the flight-to-quality phenomenon in hard period, as reflected in the significantly negative estimates for ACCESS_S. During the periods of financial turmoil, credits are limited and firms who have access to short-term public credits are those with great financial flexibilities. As a result, they are valued to a greater extent by creditors and therefore able to benefit from borrowing cheaper short-term debts. Keefe et al. (2011) find that the market value of cash is lower during economic contractions than in economic expansions. We provide relevant evidence in the strengthened negative coefficients of CASH at the 25th quantile in soft periods relative to in hard periods. It is also important to note that for constrained firms, the negative influences of asset volatility at the lower quantiles are significant in hard periods whereas insignificant in soft periods.

To conclude, the above results indicate prominent effect disparities of the conventional determinants across the conditional debt maturity distribution, in both hard and soft periods. The mechanism can be explained by the argument that risk factors associated with debt rollover are prevalent and strengthened in short debt maturities, but attenuated in long debt maturities. There is one caveat, however. On the grounds that refinancing risk is the most prevalent financial friction and that refinancing risk decreases along the debt maturity spectrum, we would expect the relations between debt maturity and its conventional determinants to be monotonic along the debt maturity spectrum. Our quantile regression results however reveal non-monotonic effects from lower to upper quantiles. For example, it is expected that size has a positive effect on debt maturity and the positive effect of size decreases along with the debt maturity level. The rationale is that the increasing refinancing risk embedded in the shorter debt maturities lean larger firms to issue more long-term debts, whereas the decreasing refinancing risk embedded in the longer debt maturities alleviate this hedging incentive. As the quantile process shows, the effect of firm size increases monotonically at the lower quantiles of the debt maturity, but then decreases monotonically at the upper quantiles. In an analogous way, the magnitude of the negative impact of market–to-book ratio is anticipated to increase along the debt maturity spectrum. The anticipated pattern is corroborated in general terms. Yet the effect is attenuated in the long debt maturity end. It appears that there is another force which moderates the effects of the conventional determinants across the debt maturity distribution. The literature concerning the passive choices of firms points to the importance of accounting for the supply side effect.

In particular, it is well documented that the relevance of financial frictions is contingent on credit access. Firms borrowing from private creditors are more likely to be strictly monitored and suffer enormously from lending barriers if the credit deteriorates (e.g., Faulkender and Petersen (2006), Sufi (2007, 2009)). In this regard, firms with access to public credits are supposed to behave in a more active way comparing with those exclusively reliant on bank loans. To address this concern, we turn to the next question of whether credit access moderates the effects of the conventional debt maturity factors along the debt maturity spectrum.

6. Does credit access moderate the effects of the conventional factors along the debt maturity spectrum?

A small but growing number of literature studies how credit access affect firms' ability and their manner to raise fund. The central argument is that firms may not be able to borrow as much and as long as they want coming down to differential credit access. On the whole, small firms with limited access to debt market face more difficulties in raising funds. By contrast, it is much easier for big firms with public credit access to take on additional long-term debts and borrow at cheaper terms (Faulkender and Petersen (2006)). Firms reliant heavily on short-term debts are obliged to repay maturing loans in high frequencies (e.g., Duchin et al., (2010), Gopalan et al. (2010)). Taken together, firms with limited credit access shall show even greater constraints if present at the short debt maturity spectrum. By contrast, big firms with flexible credit access concern less about refinancing risk. Instead, they may show higher flexibility if present at the higher debt maturity quantiles. Facing the conventional frictions associated with debt maturity choices, the former firms are likely to be too passive to take ready actions whereas the latter may be too flexible to care.

To capture this pattern, we investigate debt maturity decisions of firms with flexible access to credits separately from those of firms with limited access to credits. The classification is made based on Standard & Poor's long- or short-term bond ratings. Reconciling with Whited (1992) and Faulkender and Petersen (2006), firms who have positive debt outstanding and Standard & Poor's long- or short-term bond ratings are perceived to possess access to public credits. The rest is perceived to rely on bank loans. Then we re-estimate, for each group, Specification (8), excluding the variables of short-term and long-term public credit access.

[Insert Table IX about here]

Notably, the results displayed in Table IX uncover a clear distinction between the two types of firms. According to the medium regression results, the positive coefficients of size, age, leverage, and asset maturity are larger for firms reliant on bank loans relative to firms with public credit access. This corroborates the financial constraint literature, holding that firms who have limited credit access seek to protect themselves from liquidity and refinancing problems by borrowing long-term. However, at the 10th quantile, most variables play marginal roles for these firms. This confirms our intuition that banks rate firms who have a large portion of debts maturing in the near future as highly risky and monitor them more closely. In this case, firms may find it difficult to choose actively the desired debt maturity levels. That is, the observed debt maturities of these firms are stemming from passive choices. The pattern is reflected in the attenuated effects of the conventional frictions.

Divergent pattern is observed for firms with flexible credit access. Asset maturity plays a greatest role at the 10th debt maturity percentile. The effect gets weaker when moving from the 10th percentiles to the higher percentiles. The greatest attenuation is observed at the 90th quantiles, suggesting the asset-debt maturity mismatching in long debt maturity extremes. Note that the estimates for size and leverage even change signs. On the one hand, there exist positive effects of size and leverage at the lower quantiles, implying strong matching incentives in short debt maturity users with public access. On the other hand, the impacts of size and leverage are negative and significant at the higher quantiles, suggesting eminent mismatching patterns. The negative effects of market-to-book, R&D and abnormal earnings on debt maturity are present at most quantiles of the conditional debt maturity distribution. Yet, the magnitudes of the effects are greater at the low quantiles. It appears that firms with flexible credit access are likely to deal with incentive provisions more actively. The estimated negative effect of cash reserves at the 10th quantile is economically significant but statistically marginal for these firms.

Above all, evidence for firms with limited credit access is generally consistent with those illustrated in the prior section (see Table VI). Nevertheless, firms who have access to public credit market show distinct financing attitudes along the debt maturity spectrum. At a given quantile, some factors are more influential to the former but some are more related to the latter. The term structure of interest rate seemingly only affects debt maturity choices of firms without public credit access and that the negative effect is stronger in the long end. The coefficients of asset volatility (VOLAT) are found negative only for firms without public credit access. Firms with public credit access, the estimated coefficients are positive. Perhaps, the latter issues long-term bonds to bail them out from the refinancing dilemma, while the former fails to get long-term loans even though they may try to negotiate with their creditors.

On the whole, our results suggest that refinancing risk is a secondary concern for firms with access to public debt market. However, some may argue that given the credit availability, these firms probably employ more debts comparing with those with no access to public market. As a result, the above findings are mechanically driven by sample truncation. To provide relevant evidence, we rank and classify our sample firms into two groups using the 70% cutoff points based on the book leverage. Firms in the highest ranked group are considered as highly leveraged. We focus our analysis on a group of firms with high leverage ratios, as we believe that debt maturity choices are much more pertinent for this type of firms[6]. Further, we divide the highly leveraged firms into two subgroups: firms with public credit access (hereafter HLWSA) and firms without public credit access (hereafter HLWLA). Quantile regressions are then implemented for each group of firms, as shown in Table X. Note that leverage and credit access variables are excluded from the model.

[Insert Table X about here]

Generally speaking, these results are in line with our prior results in Table IX, confirming that HLWLA firms (shown in Panel A) are more sensitive to refinancing problems in comparison with their counter parties with sufficient credit access (shown in Panel B). The mismatching pattern reappears for HLWSA firms, particularly at the higher debt maturity quantiles. At the 75th and 90th quantiles, the estimated coefficients for size are positive in HLWLA firms, but significantly negative in HLWSA firms. Similarly, the impact of asset maturity is greatly weakened at the 90th quantile for HLWSA firms. Age plays a uniformly negative role in HLWSA firms, even at the low quantiles. The market-to-book ratio is found positively associated with debt maturity, at odds with the agency argument. By inference, this might be explained by firms' attempts to "time" long-term debt issuance subsequent to stock overvaluation. Moreover, there is a notably significant impact of abnormal earnings at the 10th debt maturity quantile for both HLWSA and HLWLA firms, with HLWSA firms affected to a larger degree. It reveals that promising future prospects bring highly leveraged firms to employ extremely short debt maturities, regardless of whether they have access to public credit access or not.

We next run quantile regressions for 482 firms with short-term public credit access. Standard and Poor's domestic short-term issuer credit rating (denoted as RATE_S) is included to

[6] We run quantile regression for low leveraged firms present below the 30% leverage cutoff. The results show that except the long-term and short-term public credit access, none of the variables is found economically significant at the 10th debt maturity quantile. To save space, these results are not presented.

capture the rating effect. The ratings "D", "C", "B-3", "B-2", "B-1", "B", "A-3", "A-2", "A-1", "A-1+"are coded as 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 respectively.

[Insert Table XI about here]

As a whole, the results reported in Panel A, Table XI are in line with our prior results for firms with public credit access. NYP and LEVERAGE affect debt maturity in a significantly negative way at the 90th percentile. AMAT is positively related to debt maturity while the effect decreases with the debt maturity quantile. MTB plays a greater role at the lower debt maturity percentiles. Some factors appear to play different roles. For instance, the effect of R&D is found relatively larger at the median debt maturity spectrum rather than at the lower quantiles. The role of ABNEARN is inconclusive, even in the lower half of the debt maturity distribution. This is perhaps due to the reason that the original sample is truncated into firms with fewer variations in R&D expenses and future abnormal earnings. The effect of RATE_S is negative and greatest at the 10th percentile. To draw further inference, Panel B examines the subgroup of highly leveraged firms whose book leverage ratios are above the 70% book leverage cutoff of the original sample. It's worthwhile to note that for these firms, the inverse role of RATE_S at the lower quantiles is even more important. It seems that firms who have higher short-term credit ratings are likely to rely more exclusively on short-term debts.

Above all, the implication of our empirical findings in this section lies in the supply-side effect. To the extent that a firm relies on bank loans, credit monitoring and control becomes binding. This supply-side constraint makes firm impotent when facing conventional frictions. Conversely, firms who are able to borrow from the public market are less likely subject to frequent monitoring. When present at the lower debt maturity quantiles, they are less constrained by credit availability in a way to treat more readily the conventional frictions. When present at the upper debt maturity quantiles, refinancing need is probably not a priority. Consequently, they would show disinclinations to pursue hedging strategies, as indicated in the reversed effects of asset maturity, leverage, etc. Given low liquidity risk, firms who have access to short-term public credit programs and are rated high would rely exclusive on debts with short maturities.

7. Robustness Checks

We report in this section several robustness tests considering the endogeneity between leverage and debt maturity, alternative debt maturity measures and others.

Debt maturity decisions are endogenously determined with leverage decisions. Do our findings suffer from endogeneity problems? To check robustness, we estimate two-stage instrumental variable quantile regressions for Specification (8).

[Insert Table XII about here]

As an instrumental variable, we incorporate predicted leverage instead of actual leverage to run quantile regressions. Following Johnson (2003), the variables used to predict book leverage are tangibility (the ratio of net property, plant, and equipment to total book assets), profitability (the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to total book assets), firm size (the percentage of NYSE firms that have the same or smaller market capitalization), asset volatility (the standard deviation of monthly stock return during a firm's fiscal year, multiplied by the share of the firm's market value of common equity to the market value of total assets), abnormal earnings (the year-by-year difference in firm's income before extraordinary items adjusted for common stock and equivalent, divided by market capitalization), a dummy variable for net operating loss carry forwards and a dummy variable for investment tax credits.

In short, our findings in terms of the heterogeneous effects of conventional factors across the debt maturity distribution are robust to this specification. The results for firms with public credit access are also consistent. On the one hand, there are effect attenuation of asset maturity and effect reversion of size at the higher debt maturity quantiles. On the other hand, the negative coefficients of cash, market-to-book and R&D ratio are more prominent at the lower quantiles (i.e., the 10^{th} or 25^{th} quantile).

So far, emphasis has been put on a value-weighted definition of debt maturity. Robustness is provided in Table XIII to define debt maturity alternatively. Specifically, we measure debt maturity as the proportion of interest bearing financial obligations with maturities of more than three years (in Panel A) and the weighted average debt maturity structure using various duration cutoffs (in Panel B and Panel C).

[Insert Table XIII about here]

Note that to calculate the weighted average debt maturity structure, we have assumed that the average durations of a firm's debts payable in year 1, 2, 3, 4, 5 and more than 5 years are 0.5, 1.5, 2.5, 3.5, 4.5 and 10 years. Panel B and Panel C reproduce our main analyses by use of alternative schemes in defining the maturity profiles: durations of 0.3 and 0.7 years for debts payable in year 1, durations of 1.3 and 1.7 years for debts payable in year 2, durations of 2.3 and 2.7 years for debts payable in year 3, durations of 3.3 and 3.7 years for debts payable in year 4, durations of 4.3 and 4.7 years for debts payable in year 5, and durations of 7 and 13 years for debts payable beyond year 5. The effects of previously included factors hold in general terms. We also perform our main analysis using the cutoff of five years to define long-term debt and excluding capital lease. The results for these analyses, unreported for brevity, are also valid.

In addition to the above robustness tests, we also checked different measures for the explanatory variables[7], incorporated additional variables (for instance a dummy for mergers and acquisitions), undid the winsorization of the explanatory variables, included non-US incorporated firms and American Depositary Receipt (ADR) and performed separate quantile regression analysis for subgroups of small and large firms[8]. The results of these analyses, unreported for brevity, show general robustness of our findings concerning the distinctive effects of conventional factors in debt maturity extremes.

8. Conclusion

There are effect disparities in the conventional debt maturity determinants. By means of the conditional quantile regression approach, we show that the relations between debt maturity and its conventional determinants vary fundamentally across the debt maturity distribution. Notably, this pattern is accentuated when we consider the upper and lower tails of the distribution. A further investigation shows that credit access moderates the above pattern to a larger degree. Specifically, more severe effect disparity unfolds for firms with public credit access.

Our empirical results can be explained by the intensified refinancing risk in the lower tail of the debt maturity distribution and the lessened refinancing risk in the upper tail. In the extremely short debt maturity scenario, rollover risk is so high that creditors are reluctant to improve their debt contracts, for instance, to lengthen the maturity structure (He and Xiong (2012a), Cheng and Milbradt (2012)). In the extremely long debt maturity scenario, rollover

[7] For example, we measured firm size as log (market value of total asset) and log (total sales), and leverage as total financial debt/total equity and total non convertible debt/total assets.
[8] Based on Fama and French (2001)'s NYSE percentile, we rank and classify firms into three size groups using the 30% and the 70% cutoff points. Firms in the highest ranked group (big firms) are considered financially unconstrained, whereas those in the lowest ranked group (small firms) are considered constrained.

risk is likely to be the last priority. Instead, other economic forces may play greater roles. The relevance of financial frictions is therefore contingent on debt maturity levels and credit accessibility of firms.

Other results are also worth noting. According to Bates et al. (2009), the average U.S. industrial firm has doubled the cash-to-assets ratio over the last three decades. Harford et al. (2014) correlate this pattern with the stylized fact of debt maturity shortening. Our analysis provides relevant evidence concerning the negative effect of cash at the lower debt maturity percentiles. Yet, we also show that this is not true for highly leveraged firms. For firms with sufficient credit access, the negative effects of growth options and future prospects are more salient in short debt maturity end, implying secondary role of refinancing risk in this type of firms. Most probably, firms' incentive to borrow cheaper through short-term public credit programs, e.g., the commercial paper program, prevails in firms with public credit access. Besides, there is a hint that highly leveraged firms with access to public debt market lengthen debt maturities when their stocks are valued high, perhaps out of timing purpose.

As suggested by Brunnermeier and Oehmke (2013), there is a possibility that short debt maturity policies of firms are inefficient due to bank runs. Consistent with this argument, our results in terms of the attenuated effects of common factors in the tails of the conditional debt maturity distribution imply that the observed debt maturity structure does not necessarily reflect the actual desires of firms. Hence, an important direction in which the current research could be extended is to examine the dynamics in debt maturity decisions. Particularly, a number of researchers hold that financing structures of firms, in a dynamic economy, are likely to deviate from the desired levels due to the presence of transaction cost (e.g., Leland (1994, 1998), Fisher et al. (1989), Goldstein et al. (2001), Ju et al. (2003) and Strebulaev (2007)). Note that this could also be true for debt maturities of firms. Research taking into account the dynamic properties of debt maturity decisions could therefore have profound implications for understanding the empirical results of the cross sections.

REFERENCES

Acharya, Viral, Douglas Gale, and Tanju Yorulmazer, 2011, Rollover risk and market freezes, *Journal of Finance* 66, 1177–1209.

Almeida, C.A.P., N.A. Debacher, A.J. Downs, L. Cottet and C.A.D. Mello, 2009, Removal of methylene blue from colored effluents by adsorption on montmorillonite clay*, Journal of Colloid and Interface Science* 332, 46-53.

Altman, Edward I., 1968, Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, *Journal of Finance* 23, 189–209.

Antoniou, Antonios, Yilmaz Guney and Krishna Paudyal, 2006, The determinants of debt maturity structure: evidence from France, Germany and the UK, *European Financial Manage* 12, 161-194.

Barclay, Michael J., and Clifford W. Smith Jr., 1995, The maturity structure of corporate debt, *Journal of Finance* 50, 609–631.

Barclay, Michael J., Clifford W. Smith Jr., and Erwan Morellec, 2006, On the debt capacity of growth options*, Journal of Business* 79, 37-59.

Barclay, Michael J., Leslie M. Marx, and Clifford W. Smith Jr., 2003, The joint determination of leverage and maturity, *Journal of Corporate Finance* 9, 149-167.

Barnea, Amir, Robert A. Haugen and Lemma W. Senbet, 1980, A rationale for debt maturity structure and call provisions in the agency theoretic framework, *Journal of Finance* 35, 1223-1234.

Barry, Christopher B., Mann, Steven C., Mihov, Vassil T. and Rodriguez, Mauricio, 2008, Corporate debt issuance and the historical level of interest rates, *Financial Management Autumn*, 413-430.

Bassett, Gilbert and Hsiu-Lang Chen, 2001, Quantile style: return-based attribution using regression quantiles, *Empirical Economics* 26, 293–305.

Bhamra, Harjoat S., Lars-Alexander Kuehn, and Ilya A. Strebulaev, 2010, The aggregate dynamics of capital structure and macroeconomic risk, *Journal of Financial Studies* 23, 4187-4241.

Berger, Allen N., Marco A. Espinosa-Vega, W. Scott Frame, and Nathan H. Miller, 2005, Debt maturity, risk, and asymmetric information, *Journal of Finance* 60, 2895-2923.

Billett, Matthew T., Tao-hsien Dolly King, and David C. Mauer, 2007, Growth opportunities and the choice of leverage, debt maturity, and covenants, *Journal of Finance* 62, 697-730.

Brick, Ivan E., and Rose C. Liao, 2013, On the determinants of debt maturity and cash holdings, Working paper.

Brockman, Paul, Xiumin Martin and Emre Unlu, 2010, Executive compensation and the maturity structure of corporate debt, *Journal of Finance* 65, 1123-1161.

Brunnermeier, Markus K. and Martin Oehmke, 2013, The maturity rate race, *The Journal of Finance* 68, 483-521.

Buchinsky, Moshe, 1994, Changes in the U.S. wage structure 1963-1987: application of quantile regression, *Econometrica* 62, 405–458.

Buchinsky, Moshe, 1995, Quantile regression, Box-Cox transformation model, and the U.S. wage structure, 1963–1987, *Journal of Econometrics* 65, 109–154.

Buchinsky, Moshe, 1998, The dynamics of changes in the female wage distribution in the USA: a quantile regression approach, *Journal of Applied Econometrics* 13, 1–30.

Campello, Murillo and Long Chen, 2010, Are financial constraints priced? evidence from firm fundamentals and stock returns, *Journal of Money, Credit, and Banking* 42, 1185-1198.

Chang, Xin and Dasgupta, Sudipto, 2009, Target behaviour and financing: how conclusive is the evidence?, *The Journal of Finance* 64, 1767-1796.

Chen, Hui, Yu Xu and jun Yang, 2012, Systematic risk, debt maturity and the term structure of credit spreads, Working paper, MIT Sloan.

Chen, Long and Xinlei Zhao, 2007, Mechanical mean reversion of leverage ratios, *Economics Letters* 95, 223-229.

Copeland, Thomas E., J. Fred Weston, and Kuldeep Shastri, 2005, Financial theory and corporate policy (4th), Pearson Education.

Custódio, Claudia, Miguel A. Ferreira and Luis Laureano, 2013, Why are US firms using more short-term debts?, *Journal of Financial Economics* 108, 182-212.

Datta, Sudip, Mai Iskandar-Datta, and Kartik Raman, 2005, Managerial stock ownership and the maturity structure of corporate debt, 2005, *Journal of Finance* 60, 2333-2350.

DeMarzo, Peter M. and Yuliy Sannikov, 2006, Optimal security design and dynamic capital structure in a continuous-time agency model, *Journal of Finance* 61, 2681-2724.

Diamond, Douglas W., 1991, Debt maturity structure and liquidity risk, *Quarterly Journal of Economics* 106, 709-737.

Diamond, Douglas W., 1993, Seniority and maturity of debt contracts, *Journal of Financial Economics* 33, 341-368.

Diamond, Douglas W. and Zhiguo He, 2014, A theory of debt maturity: the long and short of debt overhang, 2014, *The Journal of Finance* 69, 719-762.

Diamond, Douglas W. and Raghuram G. Rajan, 2001, Liquidity risk, liquidity creation, and financial fragility: A theory of banking, *Journal of Political Economy* 109, 287-327.

Duchin, Ran, Oguzhan Ozbas, and Berk A. Sensoy, 2010, Costly external finance, corporate investment, and the subprime mortgage credit crisis, *Journal of Financial Economics* 97, 418-435.

Fama, Eugene F. and Kenneth R. French, 2001, Disappearing dividends: changing firm characteristics or lower propensity to pay?, *Journal of Financial Economics* 60, 3-43.

Fan, Joseph P.H., Sheridan Titman, and Garry Twite, 2012, An international comparison of capital structure and debt maturity choices, *Journal of Financial and Quantitative Analysis* 47, 23-56.

Faulkender, Michael and Mitchell A. Petersen, 2006, Does the source of capital affect capital structure?, *The Review of Financial Studies* 19, 45- 79.

Fischer, Edwin.O., Robert Heinkel, and Josef Zechner, 1989, Dynamic capital structure choice: theory and tests, *The Journal of Finance* 44, 19-40.

Flannery, Mark J., 1986, Asymmetric information and risky debt maturity choice, *Journal of Finance* 41, 19-37.

Gomes, Leonardo, Wesley A.C. Godoy, Claudio J. Von Zuben, 2006, A review of postfeeding larval dispersal in blowflies: implications for forensic entomology. *Naturwissenschaften* 93, 207-215.

Gopalan, Radhakrishnan, Fenghua Song, and Vijay Yerramilli, 2010, Debt maturity structure and credit quality, Working paper.

Graham, John R., and Campbell R. Harvey, 2001, The theory and practice of corporate finance: Evidence from the field, *Journal of Financial Economics* 60, 186-243.

Graham, John R. and Mark T. Leary, 2011, A review of empirical capital structure research and directions for the future, *Annual Review of Financial Economics* 3, 309-345.

Guedes, Jose, and Tim Opler, 1996, The determinants of the maturity of corporate debt issues, *Journal of Finance* 51, 1809-1833.

Hackbarth, Dirk, Jianjun Miao, and Erwan Morellec, 2006, Capital structure, credit risk and macroeconomic conditions, *Journal of Financial Economics* 82, 519-550.

Harford, Jarrad, Sandy Klasa, William F. Maxwell, 2014, Refinancing risk and cash holdings, *Journal of Finance* 69, 975-1012.

He, Zhiguo, and Xiong Wei, 2012a, Dynamic debt runs, *The Review of Financial Studies* 25, 1799-1843.

He, Zhiguo, and Xiong Wei, 2012b, Rollover risk and credit risk, *Journal of Finance* 67, 391-429.

Heckman, James, 1979, Sample selection bias as a specification error, *Econometrica* 47, 153–161.

Hu, Xing, 2010, Rollover risk and credit spreads in the financial crisis of 2008, Working paper, Princeton University.

Johnson, Shane A., 2003, Debt maturity and the effects of growth opportunities and liquidity risk on leverage, *Review of Financial Studies* 16, 209-236.

Jun, Sang-Gyung, and Frank C. Jen, 2003, Trade-off model of debt maturity structure, *Review of Quantitative Finance and Accounting* 20, 5-34.

Kale, Jayant R. and Thomas H. Noe, 1990, Risky debt maturity choice in a sequential game equilibrium, *Journal of Financial Research* 13, 155-165.

Kane, Alex, Alan J. Marcus and Robert L. McDonald, 1985, Debt policy and the rate of return premium to leverage, *Journal of Financial and Quantitative Analysis* 20, 479–499.

Keefe, Michael O.C. and Robert Kieschnick, 2011, Time variation in the marginal value of firms' cash holdings, Working paper.

Koenker, Roger and Gilbert Bassett JR., 1978, Regression quantiles, *Economica* 46 , 33-49.

Koenker, Roger and Kevin F. Hallock, 2001, Quantile regression, *Journal of Economic Perspectives* 15, 143-154.

Korajczyk, Robert A., and Amnon Levy, 2003, Capital structure choice: macroeconomic conditions and financial constraints, *Journal of Financial Economics* 68, 75–109.

Leland, Hayne E. and Klaus Bjerre Toft, 1996, Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads, *Journal of Finance* 51, 987-1019.

Levy, Amnon and Christopher Hennessy, 2007, Why does capital structure choice vary with macroeconomic conditions?, *Journal of Monetary Economics* 54, 1545-1564.

Machado, José A. F. and J.M.C. Santos Silva, 2013, Quantile regression and heteroscedasticity, Working paper.

Mitchell, Karlyn, 1991, The call, sinking fund, and term-to-maturity features of corporate bonds: An empirical investigation, *Journal of Financial and Quantitative Analysis* 26, 201-223.

Mitchell, Karlyn, 1993, The debt maturity choice: an empirical investigation, *Journal of Financial Research* 16, 309-320.

Modigliani, Franco, and Merton H. Miller, 1958, The cost of capital, corporation finance, and the theory of investment, *American Economic Review* 48, 261–297.

Morris, James R., 1992, Factors affecting the maturity structure of corporate debt, Working paper.

Myers, Stewart C., 1977, Determinants of corporate borrowing, *Journal of Financial Economics* 5, 147-175.

Ozkan, Aydin, 2000, An empirical analysis of corporate debt maturity structure, *European Financial Management* 6, 197-212.

Rajan, Raghuram G., and Luigi Zingales, 1995, What do we really know about capital structure? Some evidence from international data, *Journal of Finance* 50, 1421-1460.

Rauh, Joshua and Amir Sufi, 2010, Capital structure and debt structure, *The Review of Financial Studies* 23, 4242-4280.

Saretto, Alessio, and Heather Tookes, 2011, Corporate leverage, debt maturity and credit supply: the role of credit default swaps, Working paper.

Scherr, Frederick C. and Hulburt, Heather M., 2001, The debt maturity structure of small firms, *Financial Management* 30, 85-111.

Shyam-Sunder, L. and S. Myers, 1999, Testing static trade-off against pecking order models of capital structure, *Journal of Financial Economics* 51, 219-244.

Stiglitz, Joseph E., 1974, On the irrelevance of corporate financial policy, *American Economic Review* 64, 851-66.

Stohs, Mark Hoven, and David C. Mauer, 1996, The determinants of corporate debt maturity structure, *Journal of Business* 69, 279–312.

Strebulaev, Ilya A., and Yang Baozhong, 2013, The mystery of zero-leverage firms, *Journal of Financial Economics* 109, 1-23.

Sufi, Amir, 2007, Information asymmetry and financing arrangements: evidence from syndicated loans, *The Journal of Finance* 62, 629-668.

Sufi, Amir, 2009, The real effects of debt certification: evidence from the introduction of bank loan ratings, *The Review of Financial Studies* 22, 1659-1691.

Whited, Toni M., 1992, Debt, liquidity constraints, and corporate investment: evidence from panel data, *Journal of Finance* 47, 1425-1460.

Table I

Summary of the Main Theoretical and Empirical Findings on Conventional Debt Maturity Determinants

	Theoretical Findings			Empirical Findings			
Determinants	Positive	Negative	Non-monotonic	Positive	Negative	Non-monotonic	Mixed
Size	Agency model/Liquidity Risk Model		Information Asymmetry and Liquidity Risk Model	Barclay and Smith (1995), Stohs and Mauer (1996)	Scherr and Hulburt (2001)	Guedes and Opler (1996) , Barclay et al. (2003), Johnson (2003), Datta et al. (2005) , Billet et al. (2007), Brockman et al. (2010), Custódio et al. (2012)	
Leverage	Liquidity Risk Model	Agency model		Stohs and Mauer (1996), Scherr and Hulburt (2001), Johnson (2003), Datta et al. (2005) , Brockman et al. (2010), Custódio et al. (2012)	Barclay et al. (2003), Johnson (2003), Billet et al. (2007), Billet et al. (2007)		
Credit Quality		Information Asymmetry Model	Information Asymmetry and Liquidity Risk Model		Mitchell (1991)	Barclay and Smith (1995), Stohs and Mauer (1996), Guedes and Opler (1996),	
Term Structure	Tax Model	Market Timing Model		Johnson (2003)	Barclay and Smith (1995), Guedes and Opler (1996), Datta et al. (2005), Custódio et al. (2012)		Stohs and Mauer (1996), Billet et al. (2007), Brockman et al. (2010)
Asset Maturity	Agency model/Liquidity Risk Model			Stohs and Mauer (1996), Scherr and Hulburt (2001), Brockman et al. (2010)		Guedes and Opler (1996)	Datta et al. (2005), Billet et al. (2007), Custódio et al. (2012)

Table I - Continued

	Theoretical Findings			Empirical Findings			
Determinants	Positive	Negative	Non-monotonic	Positive	Negative	Non-monotonic	Mixed
Growth Option		Agency model		Stohs and Mauer (1996), Datta et al. (2005)	Barclay and Smith (1995), Guedes and Opler (1996)		Scherr and Hulburt (2001), Johnson (2003), Billet et al. (2007), Brockman et al. (2010), Custódio et al. (2012)
Abnormal Earnings		Information Asymmetry Model			Mitchell (1991), Barclay and Smith (1995), Stohs and Mauer (1996), Johnson (2003), Billet et al. (2007)		Guedes and Opler (1996), Datta et al. (2005), Brockman et al. (2010), Custódio et al. (2012)
Age	Information Asymmetry Model			Custódio et al. (2012)	Scherr and Hulburt (2001)		
Asset Volatility		Liquidity Risk Model			Barclay and Smith (1995), Guedes and Opler (1996), Datta et al. (2005), Billet et al. (2007)		Stohs and Mauer (1996), Brockman et al. (2010), Custódio et al. (2012)
Cash		Liquidity Risk Model		Custódio et al. (2012)	Harford et al. (2011)		

Table II

Variable Definitions

Variables	Abbreviation	Expected Sign	Measurement
Size	NYP	+	Relative Size = the percentage of NYSE firms that have the same or smaller market capitalization
Reputation	AGE	+	Listing Age = the number of years and months elapsed since a firm's first CRSP listing date
Leverage	LEV	+	Book Leverage = the ratio of a firm's total debt outstanding to the book value of total assets
Asset Maturity	AMAT	+	Weighted Average Maturity of Assets = (current assets ÷ total book assets) × (current assets ÷ cost of goods sold) + (net property plant and equipment ÷ total book assets)×(net property plant and equipment ÷ depreciation and amortization)
Growth Option	MTB	-	Market-to-Book Ratio = (book value of total assets – book value of common equity + market value of common equity) ÷ book value of total assets
	R&D	-	R&D Ratio = the ratio of a firm's R&D expenses to the book value of total assets
Abnormal Earnings	ABNEARN	-	Future Abnormal Earnings = the difference of the income before extraordinary items adjusted for common stock and equivalent between year t+1 and t divided by market capitalization in calendar year t
Volatility	VOLAT	-	Relative Asset Volatility = asset volatility of a firm - asset volatility of the industry = monthly stock return standard deviation during a firm's fiscal year × (market value of common equity ÷ market value of total assets) – median (asset volatilities of firms in the industry)
Credit Access	ACCESS_L	+	Long-term Public Credit Market Access = a dummy variable which takes a value of one if Standard and Poor's domestic long-term issuer rating is available and 0 otherwise
	ACCESS_S	-	Short-term Public Debt Market Access = a dummy variable which takes a value of one if Standard and Poor's domestic short-term issuer rating is available and 0 otherwise
Cash	CASH	-	Cash holdings = The ratio of a firm's cash and short-term investment to total assets
Term Structure	TERM	-	Yield Spread between Long- and Short-term Debt = the difference of month-end yields on 10-year U.S. treasury bond and 3-month U.S. treasury bill, averaged over a firm's fiscal year period
Financial Constraint	CONSTRAINT	-	Financial Constraint = a dummy variable which takes a value of one if a firm is identified as financially constrained and 0 otherwise. Specifically, firms are sorted and categorized into three groups using the 30% and the 70% cutoff points of Altman's Zscore. Firms present in the bottom 30% are identified as financially constrained. Altman's Zscore = 1.2×T1+1.4×T2+3.3×T3+0.6×T4+1.0×T5, where T1 = working capital/total assets; T2= retained earnings/total assets; T3= EBIT/ total assets; T4= market value of equity/book value of total liabilities; T5= total sales/total assets.

Table III

Over-time Distribution of Firms by Size

This table presents the over-time distribution of firms by size. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010.

Decile	Percentage of Firms					
	1986-2011	1985 -1989	1990 -1994	1995 -1999	2000 -2004	2005 -2010
Smallest	10	9	10	13	12	6
2	10	10	11	12	10	7
3	10	12	11	11	9	7
4	10	11	11	11	9	8
5	10	11	11	10	9	10
6	10	10	10	10	10	11
7	10	9	9	9	11	12
8	10	9	9	9	11	14
9	10	9	10	8	10	13
Largest	10	11	10	8	9	13
Obs.	47161	8462	10366	10829	8748	8756

Table IV

Descriptive Statistics

This table documents descriptive statistics of long-term debt proportion (one through five years), weighted average debt maturity structure (DMAT), firm size (NYP), age (AGE), book leverage (LEV), asset maturity (AMAT), market-to-book ratio (MTB), R&D ratio (R&D), abnormal earnings (ABNEARN), volatility (VOLAT), long-term public credit access (ACCESS_L), short-term public credit access (ACCESS_S), cash holdings (CASH) and term structure of interest rate (TERM). The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The weighted average debt maturity structure is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles.

Variable	Mean	STD	P10	P25	Median	P75	P90
Proportion of debts with maturities of more than							
1 Year	0.72	0.32	0.07	0.58	0.86	0.96	1.00
2 Years	0.59	0.35	0.00	0.30	0.70	0.89	0.98
3 Years	0.48	0.35	0.00	0.12	0.53	0.79	0.95
4 Years	0.39	0.33	0.00	0.03	0.38	0.68	0.88
5 Years	0.31	0.31	0.00	0.00	0.23	0.55	0.79
DMAT	4.40	2.80	0.64	1.95	4.17	6.64	8.43
NYP	55.44	28.14	14.38	32.16	57.74	79.88	92.37
AGE	16.39	16.43	1.67	4.50	11.50	22.58	36.33
LEV	0.27	0.19	0.03	0.12	0.24	0.38	0.52
AMAT	4.58	5.17	1.08	1.76	2.99	5.34	9.57
MTB	1.80	1.46	0.90	1.08	1.38	1.96	3.03
R&D	0.03	0.08	0.00	0.00	0.00	0.03	0.10
ABNEARN	-0.03	0.53	-0.20	-0.04	0.01	0.03	0.13
VOLAT	0.01	0.06	-0.05	-0.03	-0.01	0.02	0.07
ACCESS_L	0.30	0.46	0.00	0.00	0.00	1.00	1.00
ACCESS_S	0.10	0.31	0.00	0.00	0.00	0.00	1.00
CASH	0.13	0.17	0.01	0.02	0.06	0.16	0.34
TERM	1.82	1.04	0.39	1.00	1.70	2.83	3.08

Table V

Firm Characteristics across Debt Maturity Deciles

This table presents firm characteristics across debt maturity deciles. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The weighted average debt maturity structure is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. Firm-year observations are sorted and equally categorized into 10 portfolios according to firms' debt maturity structure. The mean values of the included variables are reported for each debt maturity decile.

Variable	Deciles									
	1	2	3	4	5	6	7	8	9	10
Proportion of debts with maturities of more than										
1 Year	0,01	0,45	0,65	0,77	0,81	0,84	0,87	0,90	0,94	0,98
2 Years	<0,01	0,08	0,37	0,61	0,68	0,73	0,77	0,83	0,89	0,96
3 Years	<0,01	0,03	0,16	0,31	0,55	0,61	0,66	0,75	0,84	0,95
4 Years	<0,01	0,02	0,07	0,16	0,30	0,49	0,54	0,66	0,77	0,93
5 Years	<0,01	0,01	0,04	0,08	0,15	0,27	0,42	0,55	0,70	0,91
DMAT	0.51	1.13	1.95	2.77	3.68	4.63	5.63	6.65	7.76	9.32
NYP	37.82	39.42	43.15	49.35	54.52	60.07	65.24	69.32	69.06	66.59
AGE	9.99	11.48	13.42	14.90	16.40	18.38	20.59	22.15	20.37	16.24
LEV	0.13	0.18	0.24	0.27	0.28	0.29	0.30	0.31	0.33	0.32
AMAT	3.60	3.40	3.45	4.04	4.34	4.82	5.01	5.49	6.01	5.65
MTB	2.50	2.12	1.75	1.75	1.67	1.66	1.59	1.57	1.57	1.84
R&D	0.09	0.06	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.03
ABNEARN	0.00	-0.02	-0.03	-0.04	-0.04	-0.04	-0.03	-0.03	-0.05	-0.07
VOLAT	0.04	0.02	0.01	0.00	0.00	0.00	-0.01	-0.01	-0.01	0.00
ACCESS_L	0.03	0.05	0.09	0.16	0.24	0.33	0.43	0.55	0.59	0.62
ACCESS_S	0.01	0.02	0.04	0.06	0.09	0.14	0.19	0.22	0.19	0.10
CASH	0.23	0.18	0.11	0.10	0.10	0.10	0.09	0.09	0.10	0.15
TERM	1.81	1.80	1.84	1.85	1.82	1.79	1.84	1.82	1.84	1.75

Table VI

Regression Results: the Effects of Debt Maturity Determinants across the Maturity Spectrum

This table documents the OLS results (in the first column of Panel A), the 10th, 25th, 50th, 75th, 90th quantile regression results (in the second to the sixth columns of Panel A) and the 50th-10th, 50th-25th, 75th-50th, 90th-50th, 75th-25th and 90th-10th interquantile regression results (in Panel B) for the effects of debt maturity determinants. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model for the quantile regressions is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}TERM_{i,t-1} + \beta_{12\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1,\ldots,n; t = 1,\ldots,T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are reported for OLS& quantile regressions. Interquantile regressions are computed using the bootstrapping method. ***, ** and * show that the coefficient is significantly correlated at 1%, 5% and 10% level respectively.

	Panel A : OLS & Quantile Regression											
	OLS		10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	1.785	0.072***	0.066	0.048	0.250	0.053***	0.966	0.072***	2.836	0.130***	5.642	0.155***
NYP	0.030	0.001***	0.013	0.001***	0.024	0.001***	0.034	0.001***	0.037	0.002***	0.025	0.002***
AGE	<0.001	0.002	0.004	0.002**	0.003	0.002*	0.001	0.002	-0.004	0.002*	-0.005	0.002**
LEV	2.984	0.124***	2.136	0.109***	2.952	0.113***	3.497	0.157***	3.066	0.199***	1.596	0.185***
AMAT	0.049	0.005***	0.024	0.005***	0.051	0.006***	0.069	0.006***	0.062	0.010***	0.044	0.005***
MTB	-0.193	0.015***	-0.138	0.014***	-0.182	0.015***	-0.202	0.016***	-0.221	0.025***	-0.118	0.042***
R&D	-1.963	0.255***	-0.346	0.135***	-0.850	0.163***	-1.775	0.250***	-3.038	0.398***	-2.621	0.603***
ABNEARN	-0.089	0.019***	-0.051	0.013***	-0.053	0.018***	-0.096	0.027***	-0.100	0.032***	-0.103	0.034***
VOLAT	-0.557	0.360	0.604	0.177***	-0.079	0.223	-0.882	0.319***	-2.054	0.657***	-0.669	0.668
ACCESS_L	1.500	0.061***	1.468	0.085***	1.813	0.078***	1.846	0.081***	1.647	0.089***	1.355	0.078***
ACCESS_S	-0.778	0.086***	-0.107	0.127	-0.428	0.124***	-0.807	0.102***	-1.139	0.117***	-1.224	0.110***
CASH	0.634	0.187***	-0.269	0.113**	-0.390	0.114***	0.057	0.180	2.438	0.316***	3.409	0.284***
TERM	-0.046	0.011***	-0.020	0.008**	-0.031	0.010***	-0.044	0.013***	-0.065	0.019***	-0.078	0.022***
CONSTRAINT	-0.123	0.047***	-0.022	0.038	-0.044	0.045	-0.188	0.052***	-0.188	0.077**	-0.085	0.077
CONSTRAINT×VOLAT	-1.194	0.489**	-0.955	0.298***	-0.815	0.331**	-0.403	0.463	-0.525	0.753	-2.351	0.899***
CONSTRAINT×CASH	0.381	0.227*	0.280	0.117**	0.550	0.150***	0.532	0.253**	-0.242	0.471	-0.251	0.474
R^2	0.3042		0.2843		0.2959		0.3028		0.2943		0.2419	

Table VI - Continued

	Panel B: Interquantile Regression											
	10th-50th		25th-50th		10th-25th		90th-50th		75th-50th		90th-75th	
	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.	Est.	Std. Err.
Intercept	-0.901	0.043***	-0.717	0.043***	-0.184	0.034***	4.676	0.091***	1.870	0.060***	2.806	0.089***
NYP	-0.021	0.001***	-0.011	0.001***	-0.010	0.001***	-0.009	0.001***	0.003	0.001***	-0.012	0.001***
AGE	0.004	0.001***	0.003	0.001**	0.001	0.001	-0.006	0.001***	-0.005	0.001***	-0.001	0.001
LEV	-1.361	0.083***	-0.546	0.060***	-0.816	0.073***	-1.901	0.132***	-0.431	0.096***	-1.470	0.102***
AMAT	-0.045	0.003***	-0.018	0.003***	-0.027	0.002***	-0.025	0.005***	-0.007	0.005	-0.018	0.005***
MTB	0.064	0.012***	0.019	0.007***	0.045	0.008***	0.083	0.027***	-0.019	0.010*	0.103	0.024***
R&D	1.430	0.126***	0.925	0.122***	0.505	0.086***	-0.846	0.416**	-1.263	0.216**	0.417	0.351
ABNEARN	0.044	0.030	0.043	0.027	0.002	0.014	-0.007	0.042	-0.004	0.030	-0.004	0.033
VOLAT	1.486	0.211***	0.803	0.135***	0.683	0.152***	0.213	0.729	-1.173	0.467**	1.385	0.667**
ACCESS_L	-0.378	0.066***	-0.033	0.050	-0.345	0.046***	-0.491	0.061***	-0.199	0.063***	-0.292	0.059***
ACCESS_S	0.699	0.068***	0.379	0.053***	0.320	0.074***	-0.417	0.058***	-0.333	0.044***	-0.085	0.073
CASH	-0.326	0.128**	-0.448	0.087***	0.121	0.052**	3.351	0.166***	2.381	0.146***	0.970	0.230***
TERM	0.024	0.014*	0.013	0.012	0.011	0.009	-0.033	0.020*	-0.020	0.019	-0.013	0.016
CONSTRAINT	0.166	0.028***	0.143	0.038***	0.022	0.025	0.103	0.061*	0.000	0.057	0.103	0.045**
CONSTRAINT×VOLAT	-0.551	0.426	-0.411	0.271	-0.140	0.346	-1.948	0.851**	-0.122	0.609	-1.826	0.730**
CONSTRAINT×CASH	-0.252	0.102**	0.018	0.130	-0.270	0.090***	-0.782	0.350**	-0.773	0.285***	-0.009	0.323

Table VII

The Persistence of the Effects of Debt Maturity Determinants across the Maturity Spectrum

This table reports the persistence of the effects of debt maturity determinants across the debt maturity distribution. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. For annual cross sections over the period from 1986 to 2010, we calculate how often the estimated coefficients of a covariate specified in the empirical model are found statistically significant at the conventional significance levels (1%, 5% and 10%) in a specific sign (positive or negative). The statistics of OLS regressions are presented in the first column of the table and the statistics of the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} quantile regressions are presented in the rest of the columns. The empirical model for the quantile regressions is specified as follows,

$$Q_\theta\left(DMAT_{i,t}\middle|X_{i,t-1}\right) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1, \dots, n; t = 1, \dots, T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1^{st} and 99^{th} percentiles. Clustered standard errors by firm are computed.

	OLS		10^{th} Quantile		25^{th} Quantile		50^{th} Quantile		75^{th} Quantile		90^{th} Quantile	
	+ %	- %	+ %	- %	+ %	- %	+ %	- %	+ %	- %	+ %	- %
NYP	100		100		100		100		100		100	
AGE	12	16	12	4	20	4	12	16	4	28		28
LEV	100		100		100		100		96		80	
AMAT	100		76		96		96		88		48	
MTB		96		92		100		96		84		40
R&D		64		8		40		64		44	4	28
ABNEARN	4	36	8	32	4	24	4	32	8	28	8	12
VOLAT		12	20		8			20		36	8	20
ACCESS_L	100		100		100		100		100		100	
ACCESS_S		88	16	36	8	60	4	88		92		92
CASH	48			20		24	16	12	68		96	
CONSTRAINT	8	28	16	20	20	20	4	20	4	20	4	16
CONSTRAINT×VOLAT		12	4	20		16		4		8		8
CONSTRAINT×CASH	16	12	24	8	16	4	20		4	16	4	12

Table VIII

Economic Conditions and the Effects of Debt Maturity Determinants across the Maturity Spectrum

This table shows the 10th, 25th, 50th, 75th and 90th quantile regression results for subperiods of hard and soft economic conditions. The original sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. Term structure of interest rate is used to sort and classify firm-year observations into three groups using the 30% and the 70% cutoff points. Observations in the highest ranked group are considered in soft periods, whereas those in the lowest ranked group are considered in hard periods. The empirical model is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1,\ldots,n; t = 1,\ldots,T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Hard Periods									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.100	0.054*	0.273	0.062*	0.893	0.097***	2.600	0.185***	5.520	0.224***
NYP	0.011	0.001***	0.021	0.001***	0.032	0.002***	0.035	0.002***	0.022	0.003***
AGE	0.005	0.002**	0.004	0.002**	0.003	0.003	-0.003	0.003	-0.005	0.003
LEV	1.966	0.154***	2.755	0.167***	3.492	0.230***	3.213	0.305***	1.605	0.286***
AMAT	0.021	0.007***	0.049	0.009***	0.071	0.009***	0.077	0.010***	0.058	0.008***
MTB	-0.105	0.019***	-0.158	0.018***	-0.184	0.023***	-0.193	0.034***	-0.101	0.033***
R&D	-0.403	0.185**	-0.984	0.244***	-2.071	0.324***	-3.368	0.446***	-1.479	1.227
ABNEARN	-0.030	0.016*	-0.010	0.018	-0.020	0.024	-0.057	0.063	-0.046	0.047
VOLAT	0.337	0.228	-0.249	0.279	-0.766	0.419*	-1.523	1.337	-0.751	1.608
ACCESS_L	1.620	0.129***	2.033	0.105***	2.070	0.108***	1.768	0.135***	1.516	0.123***
ACCESS_S	-0.337	0.149**	-0.677	0.157***	-1.100	0.143***	-1.353	0.152***	-1.443	0.152***
CASH	-0.251	0.149*	-0.293	0.157*	0.048	0.230	2.814	0.579***	3.780	0.364***
CONSTRAINT	-0.021	0.056	-0.085	0.062	-0.266	0.075***	-0.227	0.121*	-0.093	0.136
CONSTRAINT×VOLAT	-0.917	0.437**	-1.024	0.527*	-0.853	0.605	-0.581	1.558	-2.195	1.766
CONSTRAINT×CASH	0.405	0.193**	0.835	0.245***	1.514	0.359***	0.561	0.737	-0.022	0.791
	Soft Periods									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.066	0.060	0.023	0.073	0.867	0.097***	2.687	0.177***	5.415	0.245***
NYP	0.014	0.001***	0.024	0.001***	0.033	0.002***	0.036	0.002***	0.026	0.003***
AGE	0.004	0.002*	0.005	0.002**	0.001	0.002	-0.004	0.003	-0.005	0.003
LEV	2.130	0.154***	2.867	0.161***	3.115	0.204***	2.806	0.304***	1.573	0.313***
AMAT	0.027	0.007***	0.053	0.008***	0.068	0.008***	0.064	0.011***	0.037	0.008***
MTB	-0.155	0.020***	-0.172	0.026***	-0.184	0.021***	-0.237	0.030***	-0.165	0.050***
R&D	-0.142	0.152	-0.544	0.181***	-1.341	0.261***	-2.291	0.502***	-3.118	0.896***
ABNEARN	-0.059	0.063	-0.073	0.077	-0.166	0.094*	-0.179	0.141	-0.257	0.220
VOLAT	0.445	0.274	0.006	0.361	-1.210	0.446***	-3.853	1.036***	-3.730	1.131***
ACCESS_L	1.327	0.104***	1.682	0.115***	1.889	0.110***	1.778	0.137***	1.418	0.128***
ACCESS_S	0.151	0.168	-0.230	0.181	-0.633	0.109***	-1.073	0.151***	-1.096	0.189***
CASH	-0.134	0.142	-0.467	0.168***	-0.213	0.273	2.246	0.501***	3.475	0.361***
CONSTRAINT	0.126	0.054**	0.148	0.069**	0.005	0.071	-0.096	0.112	-0.050	0.134
CONSTRAINT×VOLAT	-0.663	0.437	-0.827	0.518	0.112	0.626	0.839	1.294	-0.912	1.843
CONSTRAINT×CASH	-0.284	0.189	-0.093	0.222	-0.196	0.300	-1.480	0.711**	-0.859	0.987

Table IX

Credit Access and the Effects of Debt Maturity Determinants across the Maturity Spectrum

This table shows the 10th, 25th, 50th, 75th and 90th quantile regression results for the effects of debt maturity determinants for subgroups of firms, that is, firms without public credit access and firms with public credit access. The original sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. Standard and Poor's bond ratings (both long-term and short-term) are used to categorize firms into two subgroups. Firms with positive debt outstanding but lack of Standard and Poor's long- or short-term bond ratings are considered to have no access to public credit and the remainder is considered to have access to public credit. The empirical model is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \quad i = 1,\dots,n; t = 1,\dots,T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Firms without Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.200	0.038***	0.248	0.053***	0.634	0.080***	1.964	0.153***	4.578	0.201***
NYP	0.009	0.001***	0.021	0.001***	0.034	0.001***	0.041	0.002***	0.033	0.002***
AGE	0.004	0.002**	0.009	0.002***	0.015	0.003***	0.017	0.004***	0.014	0.005**
LEV	1.881	0.095***	3.058	0.119***	3.935	0.179***	4.014	0.283***	2.589	0.279***
AMAT	0.012	0.004***	0.039	0.007***	0.081	0.009***	0.102	0.011***	0.077	0.008***
MTB	-0.078	0.008***	-0.141	0.012***	-0.182	0.015***	-0.211	0.024***	-0.178	0.054***
R&D	-0.208	0.085**	-0.604	0.118***	-1.220	0.184***	-2.271	0.347***	-1.455	1.271
ABNEARN	-0.031	0.011***	-0.035	0.016**	-0.032	0.025	-0.022	0.049	0.024	0.066
VOLAT	-0.048	0.137	-0.387	0.191**	-0.810	0.314***	-2.045	0.735***	-0.986	1.256
CASH	-0.167	0.077**	-0.330	0.106***	-0.065	0.171	2.043	0.514***	3.730	0.346***
TERM	-0.011	0.007	-0.029	0.010***	-0.049	0.016***	-0.089	0.026***	-0.135	0.035***
CONSTRAINT	-0.133	0.035***	-0.190	0.044***	-0.275	0.060***	-0.308	0.095***	-0.124	0.117
CONSTRAINT×VOLAT	-0.173	0.251	-0.234	0.318	0.109	0.431	-0.548	0.900	-2.886	1.492*
CONSTRAINT×CASH	0.261	0.087***	0.540	0.127***	0.526	0.213**	0.093	0.636	-0.100	0.525
	Firms with Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.198	0.285	2.164	0.301***	6.363	0.314***	9.851	0.217***	10.819	0.149***
NYP	0.032	0.003***	0.030	0.003***	0.000	0.004	-0.021	0.002***	-0.020	0.002***
AGE	0.003	0.003	-0.004	0.002*	-0.008	0.002***	-0.012	0.002***	-0.012	0.002***
LEV	2.848	0.382***	2.353	0.333***	1.006	0.306***	-0.390	0.217*	-0.597	0.176***
AMAT	0.065	0.010***	0.059	0.008***	0.039	0.010***	0.020	0.006***	0.001	0.005
MTB	-0.440	0.048***	-0.481	0.055***	-0.236	0.093**	-0.003	0.058	0.052	0.038
R&D	-5.511	1.133***	-8.318	2.411***	-6.048	2.096***	-2.465	1.118**	-1.911	0.678***
ABNEARN	-0.194	0.024***	-0.153	0.065**	-0.158	0.030***	-0.051	0.037	-0.029	0.025
VOLAT	0.275	1.233	1.276	1.657	4.754	1.671***	4.370	1.378***	3.373	1.068***
CASH	-1.181	0.693*	0.659	0.655	4.114	0.540***	3.871	0.471***	2.852	0.307***
TERM	-0.024	0.027	-0.030	0.028	-0.007	0.025	-0.024	0.021	0.025	0.018
CONSTRAINT	0.097	0.134	0.185	0.126	0.268	0.104***	0.259	0.091***	0.145	0.077*
CONSTRAINT×VOLAT	1.071	2.209	-1.225	2.379	-2.302	1.965	-1.041	1.946	-0.098	1.268
CONSTRAINT×CASH	2.751	0.868***	1.021	1.206	-1.819	0.703***	-1.437	0.541***	-1.096	0.387***

Table X

Capital Structure, Credit Access and the Effects of Debt Maturity Determinants across the Maturity Spectrum

This table shows the 10th, 25th, 50th, 75th and 90th quantile regression results for the effects of debt maturity determinants for subgroups of firms: highly leveraged firms without public access versus highly leveraged firms with public access. The original sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. Book leverage (the ratio of a firm's total debt outstanding to book assets) is used to sort and categorize firms into three groups using the 30% and the 70% cutoff points. Firms in the highest ranked group are considered highly leveraged, whereas those in the lowest ranked group are considered low leveraged. Standard and Poor's bond ratings (both long-term and short-term) are used to categorize firms into two subgroups. Highly leveraged firms without public access are those lack of Standard and Poor's bond ratings and present in the highest leverage group. Highly leveraged firms with public access are those with Standard and Poor's bond ratings and present in the highest leverage group. The empirical model is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}AMAT_{i,t-1} + \beta_{4\theta}MTB_{i,t-1} + \beta_{5\theta}R\&D_{i,t-1} + \beta_{6\theta}ABNEARN_{i,t} + \beta_{7\theta}VOLAT_{i,t-1} + \beta_{8\theta}ACCESS\_L_{i,t-1} + \beta_{9\theta}ACCESS\_S_{i,t-1} + \beta_{10\theta}TERM_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1,\dots,n\ t = 1,\dots,T$$

The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Highly Leveraged Firms without Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.416	0.087***	0.866	0.099***	1.808	0.141***	3.411	0.193***	5.924	0.281***
NYP	0.024	0.001***	0.033	0.002***	0.041	0.002***	0.037	0.003***	0.024	0.003***
AGE	0.007	0.003**	0.005	0.003*	0.001	0.005	-0.001	0.006	-0.007	0.010
AMAT	0.052	0.008***	0.077	0.008***	0.098	0.010***	0.096	0.010***	0.061	0.008***
MTB	-0.146	0.020***	-0.245	0.030***	-0.293	0.050***	-0.195	0.049***	-0.149	0.100
R&D	-0.450	0.278	-0.864	0.460*	-1.612	0.548***	-2.970	0.316***	-1.365	1.014
ABNEARN	-0.078	0.034**	-0.078	0.040**	-0.041	0.044	-0.028	0.054	0.030	0.059
VOLAT	-1.899	0.488***	-2.209	0.679***	-2.082	1.163*	-3.849	1.013***	-1.752	1.435
CASH	0.383	0.417	1.997	0.773***	6.069	0.632***	7.273	0.427***	6.877	0.753***
TERM	0.019	0.022	0.020	0.025	-0.051	0.033	-0.096	0.042**	-0.108	0.058*
CONSTRAINT	-0.003	0.059	0.159	0.077**	0.312	0.099***	0.490	0.129***	0.444	0.169***
CONSTRAINT×VOLAT	-0.434	0.680	-0.155	0.958	-0.882	1.404	0.451	1.376	-1.891	2.028
CONSTRAINT×CASH	-0.342	0.449	-0.983	0.779	-3.371	0.910***	-2.033	0.618***	-2.443	0.864***
	Highly Leveraged Firms with Public Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	1.960	0.358***	3.624	0.440***	6.508	0.310***	9.238	0.241***	10.241	0.161***
NYP	0.025	0.003***	0.023	0.003***	-0.001	0.004	-0.017	0.003***	-0.018	0.002***
AGE	-0.007	0.004*	-0.014	0.004***	-0.013	0.003***	-0.014	0.003***	-0.012	0.003***
AMAT	0.043	0.013***	0.034	0.011***	0.016	0.008**	0.008	0.009	0.001	0.004
MTB	-0.282	0.133**	-0.341	0.219	0.056	0.074	0.124	0.081	0.171	0.062***
R&D	-12.332	4.020***	-6.826	3.889*	-5.616	4.239	-1.011	1.366	-0.653	0.711
ABNEARN	-0.159	0.040***	-0.112	0.095	-0.139	0.049***	-0.064	0.049	-0.019	0.020
VOLAT	-2.054	2.729	-2.861	3.745	-0.718	2.329	1.404	2.165	0.787	1.926
CASH	2.996	2.246	5.495	0.892***	4.982	0.615***	3.526	0.543***	2.504	0.530***
TERM	-0.039	0.048	-0.078	0.042*	-0.013	0.036	-0.101	0.030***	-0.029	0.026
CONSTRAINT	0.505	0.218**	0.669	0.205***	0.584	0.139***	0.452	0.111***	0.186	0.115
CONSTRAINT×VOLAT	5.177	3.282	4.810	3.918	3.651	2.636	2.164	2.440	1.524	1.944
CONSTRAINT×CASH	-0.380	2.259	-2.944	1.366**	-2.560	0.931***	-1.686	0.590***	-1.029	0.582*

Table XI

Robustness Check: Short-term Public Credit Access

This table shows the 10th, 25th, 50th, 75th and 90th quantile regression results for the effects of debt maturity determinants for a subgroup of firms with access to short-term public credit. The sample consists of 482 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. Firms with positive debt outstanding and Standard and Poor's short-term bond ratings are considered to have access to short-term public credit (results shown in Panel A), among which highly leveraged firms are those above the 70% book leverage cutoff of the original sample (results shown in Panel B). The empirical model is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \beta_{16\theta}RATE\_S_{i,t-1} + \varepsilon_{i,t} \qquad i = 1,\ldots,n; t = 1,\ldots,T$$

RATE_S is Standard and Poor's domestic short-term issuer credit rating, coded as 0 for the rating "D", 1 for the rating "C", 2 for the rating "B-3", 3 for the rating "B-2", 4 for the rating "B-1", 5 for the rating "B", 6 for the rating "A-3", 7 for the rating "A-2", 8 for the rating "A-1", 9 for the rating "A-1+". The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

	Panel A: Firms with Short-Term Credit Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.332	1.575	1.848	1.329	6.707	1.147***	10.340	1.078***	12.177	1.067***
NYP	0.065	0.020***	0.046	0.016***	0.008	0.015	-0.015	0.012	-0.033	0.011***
AGE	0.000	0.004	-0.006	0.004*	-0.005	0.004	-0.010	0.003***	-0.006	0.003*
LEVERAGE	1.509	0.677**	1.381	0.772*	0.045	0.674	-0.838	0.710	-1.646	0.662**
AMAT	0.117	0.015***	0.086	0.015***	0.069	0.016***	0.049	0.019***	0.052	0.026**
MTB	-0.499	0.091***	-0.545	0.079***	-0.418	0.142***	-0.208	0.129	-0.065	0.041
R&D	-6.703	3.163**	-7.136	3.209**	-8.128	3.169***	-6.715	2.842**	-6.639	3.296**
ABNEARN	-0.016	0.105	0.070	0.128	-0.050	0.062	0.148	0.054***	0.228	0.044***
VOLAT	-3.061	2.161	-1.271	2.574	2.191	3.369	0.978	2.129	3.182	3.000
CASH	-3.076	1.129***	-1.768	1.662	2.118	2.146	4.334	1.249***	5.488	1.182***
TERM	0.050	0.032	0.084	0.037**	0.081	0.034**	0.029	0.035	0.048	0.037
CONSTRAINT	0.328	0.239	0.425	0.202**	0.094	0.211	0.059	0.183	0.098	0.181
CONSTRAINT×VOLAT	14.587	4.381***	14.235	6.475**	1.342	5.772	-1.499	5.340	-1.202	4.440
CONSTRAINT×CASH	1.828	2.437	1.683	3.408	0.090	3.693	-1.305	1.838	-0.782	1.578
RATE_S	-0.286	0.075***	-0.141	0.083*	-0.128	0.078	-0.153	0.060**	-0.075	0.053

	Panel A: High Leveraged Firms with Short-Term Credit Access									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	1.169	2.700	4.578	1.870**	6.708	2.462***	10.300	1.545***	11.833	1.252***
NYP	0.070	0.035**	0.047	0.023**	0.018	0.032	-0.014	0.016	-0.033	0.011***
AGE	-0.007	0.006	-0.016	0.006***	-0.013	0.007*	-0.012	0.006**	-0.002	0.005
LEVERAGE	-2.976	1.711*	-1.529	1.189	-0.682	1.525	-0.656	1.168	-0.946	1.180
AMAT	0.089	0.021***	0.060	0.028**	0.058	0.024**	0.036	0.018**	0.053	0.028*
MTB	-0.519	0.190***	-0.630	0.238***	-0.659	0.286**	-0.295	0.168*	-0.122	0.221
R&D	-1.353	8.755	0.242	10.492	1.433	3.756	-1.381	3.136	-5.229	1.496***
ABNEARN	0.648	0.541	0.407	0.151***	0.408	0.455	0.026	0.762	0.053	0.132
VOLAT	-7.105	5.474	-3.750	8.138	-7.898	4.923	-7.260	4.857	-14.444	4.361***
CASH	2.053	2.604	-0.654	3.131	4.405	1.748**	2.993	1.437**	3.053	1.502**
TERM	0.126	0.082	0.208	0.065***	0.159	0.073**	-0.041	0.063	0.021	0.060
CONSTRAINT	0.709	0.409*	0.293	0.353	0.438	0.401	0.263	0.284	0.291	0.271
CONSTRAINT×VOLAT	18.485	4.527***	19.419	7.161***	21.320	9.139**	10.188	8.977	18.265	5.429***
CONSTRAINT×CASH	-2.426	3.816	-1.443	5.070	-5.052	4.773	-3.679	3.521	-0.720	1.880
RATE_S	-0.336	0.104***	-0.311	0.110***	-0.167	0.134	-0.114	0.080	-0.091	0.067

Table XII

Robustness Check: Endogeneity

This table documents two-stage instrumental variable quantile regression results at the 10th, 25th, 50th, 75th, 90th quantiles for the effects of debt maturity determinants. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model is specified as follows,

$$Q_\theta(DMAT_{i,t}|X_{i,t-1}) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV(Predicted)_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}TERM_{i,t-1} + \beta_{12\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1,\dots,n;\ t = 1,\dots,T$$

Specifically, we use the predicted book leverage instead of the actual book leverage. The variables used to predict book leverage include tangibility (the ratio of net property, plant, and equipment to total book assets), profitability (the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to total book assets), firm size (the percentage of NYSE firms that have the same or smaller market capitalization), asset volatility (the standard deviation of monthly stock return during a firm's fiscal year, multiplied by the share of the firm's market value of common equity to the market value of total assets), abnormal earnings (the year-by-year difference in firm's income before extraordinary items adjusted for common stock and equivalent, divided by market capitalization), a dummy variable for net operating loss carryforwards and a dummy variable for investment tax credits. The weighted average debt maturity structure (DMAT) is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. Clustered standard errors by firm are computed. ***,** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: the effects of debt maturity determinants across the maturity spectrum

	Quantile Regression									
	10th Quantile		25th Quantile		50th Quantile		75th Quantile		90th Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.385	0.124***	-0.189	0.142	0.701	0.167***	2.809	0.254***	5.685	0.347***
NYP	0.015	0.001***	0.025	0.002***	0.035	0.002***	0.034	0.002***	0.021	0.003***
AGE	-0.001	0.003	-0.002	0.003	-0.006	0.003**	-0.010	0.003***	-0.007	0.003**
LEV (Predicted)	3.708	0.447***	4.673	0.522***	5.130	0.503***	4.394	0.740***	1.686	0.927*
AMAT	0.034	0.013***	0.066	0.017***	0.063	0.010***	0.049	0.013***	0.038	0.012***
MTB	-0.171	0.036***	-0.222	0.033***	-0.241	0.044***	-0.262	0.046***	-0.085	0.049*
R&D	-0.612	0.312**	-1.406	0.390***	-2.900	0.602***	-2.642	0.806***	-2.108	1.058**
ABNEARN	-0.030	0.027	-0.018	0.033	-0.134	0.051***	-0.087	0.060	-0.129	0.037***
VOLAT	0.499	0.368	-0.093	0.452	-1.281	0.734*	-0.834	1.143	-0.195	1.271
ACCESS_L	1.599	0.120***	1.955	0.109***	1.949	0.122***	1.825	0.113***	1.501	0.108***
ACCESS_S	0.022	0.168	-0.380	0.144***	-0.857	0.120***	-1.114	0.150***	-1.012	0.137***
CASH	-1.071	0.269***	-0.942	0.259***	0.281	0.472	3.402	0.459***	4.152	0.405***
TERM	-0.021	0.015	-0.033	0.018*	-0.039	0.020*	-0.044	0.027*	-0.012	0.031
CONSTRAINT	0.141	0.064**	0.140	0.080*	0.087	0.083	0.068	0.104	0.061	0.117
CONSTRAINT×VOLAT	-1.655	0.678**	-1.311	0.700*	-2.047	1.053*	-2.578	1.686	-3.172	1.865*
CONSTRAINT×CASH	0.441	0.271	0.451	0.276	0.144	0.568	-1.535	0.734**	-1.266	0.721*
R^2	0.2416		0.2547		0.2636		0.2477		0.1950	

Table XII – Continued

Panel B: credit access and the effects of debt maturity determinants across the maturity spectrum

	Firms without Public Access									
	10^{th} Quantile		25^{th} Quantile		50^{th} Quantile		75^{th} Quantile		90^{th} Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.391	0.102***	-0.629	0.167***	-0.141	0.219	1.459	0.333***	4.369	0.493***
NYP	0.013	0.001***	0.026	0.002***	0.039	0.002***	0.042	0.003***	0.031	0.003***
AGE	-0.001	0.003	0.003	0.004	0.006	0.005	0.003	0.006	0.007	0.009
LEV (Predicted)	4.027	0.398***	6.420	0.740***	7.191	0.888***	6.742	1.111***	2.818	1.520*
AMAT	0.011	0.006*	0.041	0.028	0.089	0.025***	0.101	0.021***	0.082	0.012***
MTB	-0.084	0.018***	-0.149	0.028***	-0.192	0.048***	-0.211	0.050***	-0.106	0.043**
R&D	-0.457	0.197**	-1.078	0.332***	-2.006	0.508***	-2.777	0.863***	-1.617	1.317
ABNEARN	0.008	0.026	0.024	0.029	0.024	0.096	0.071	0.044	0.056	0.083
VOLAT	-0.234	0.252	-0.795	0.424*	-1.707	0.629***	-1.546	1.200	-0.639	1.198
CASH	-0.612	0.115***	-0.891	0.270***	-0.064	0.482	3.291	0.671***	4.794	0.462***
TERM	-0.003	0.013	-0.024	0.019	-0.051	0.026**	-0.051	0.038	-0.033	0.051
CONSTRAINT	-0.026	0.059	-0.010	0.078	0.068	0.107	0.139	0.158	0.236	0.185
CONSTRAINT×VOLAT	-0.278	0.461	-0.322	0.729	-0.706	1.117	-2.463	1.603	-4.293	2.431*
CONSTRAINT×CASH	0.166	0.180	0.534	0.284*	-0.095	0.633	-2.285	1.316*	-2.041	0.916**
	Firms with Public Access									
	10^{th} Quantile		25^{th} Quantile		50^{th} Quantile		75^{th} Quantile		90^{th} Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-2.775	0.707***	0.180	0.798	3.929	0.887***	8.095	0.703***	9.613	0.466***
NYP	0.050	0.005***	0.044	0.005***	0.017	0.007**	-0.009	0.005*	-0.012	0.003***
AGE	0.000	0.003	-0.008	0.003**	-0.009	0.003***	-0.011	0.003***	-0.012	0.003***
LEV (Predicted)	7.419	1.152***	5.294	1.247***	4.468	1.261***	2.365	1.052**	1.581	0.786**
AMAT	0.075	0.012***	0.057	0.010***	0.036	0.012***	0.020	0.009**	-0.002	0.007
MTB	-0.399	0.093***	-0.404	0.057***	-0.277	0.097***	-0.125	0.126	0.021	0.072
R&D	-2.609	2.197	-6.163	2.879**	-3.350	2.986	1.642	1.253	-0.144	0.807
ABNEARN	-0.204	0.057***	-0.237	0.087***	-0.274	0.109**	-0.146	0.037***	-0.034	0.026
VOLAT	-1.936	2.049	-1.092	1.967	3.842	2.527	6.809	2.001***	4.314	1.452***
CASH	-2.853	0.780***	-0.713	0.913	4.426	1.057***	4.330	0.639***	2.984	0.533***
TERM	-0.028	0.046	-0.048	0.041	-0.017	0.032	-0.018	0.035	0.023	0.027
CONSTRAINT	0.261	0.184	0.218	0.173	0.323	0.141**	0.098	0.120	-0.053	0.116
CONSTRAINT×VOLAT	-0.820	2.944	-2.111	2.958	-2.319	3.286	-3.198	2.713	-0.840	1.899
CONSTRAINT×CASH	5.189	1.226***	2.777	1.101**	-1.790	1.189	-1.471	0.791*	-0.796	0.765

Table XIII

Regression Results: Alternative Debt Maturity Definitions

This table shows the 10^{th}, 25^{th}, 50^{th}, 75^{th}, 90^{th} quantile regression results for the effects of debt maturity determinants. In panel A, debt maturity (DMAT) is defined as the proportion of interest bearing financial obligations with maturities of more than three years. In panel B & panel C, debt maturity (DMAT) is calculated as the weighted average debt maturity structure of a firm's total debt based on two different duration schemes. Panel B defines the duration of 0.3 years for debts payable in year 1, 1.3 years for debts payable in year 2, 2.3 years for debts payable in year 3, 3.3 years for debts payable in year 4, 4.3 years for debts payable in year 5, and 7 years for debts payable beyond year 5. Panel C defines the duration of 0.7 years for debts payable in year 1, 1.7 years for debts payable in year 2, 2.7 years for debts payable in year 3, 3.7 years for debts payable in year 4, 4.7 years for debts payable in year 5, and 13 years for debts payable beyond year 5. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model is specified as follows,

$$Q_\theta\left(DMAT_{i,t}\middle|X_{i,t-1}\right) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}TERM_{i,t-1} + \beta_{12\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1,\ldots,n;\ t = 1,\ldots,T$$

Other variables are defined in Table II and are winsorized at the 1^{st} and 99^{th} percentiles. Clustered standard errors by firm are computed. ***, ** and * show that the coefficient is significant at 1%, 5% and 10% level respectively.

Panel A: Debt maturity (DMAT) is calculated as the proportion of interest bearing financial obligations with maturities of more than three years

	10^{th} Quantile		25^{th} Quantile		50^{th} Quantile		75^{th} Quantile		90^{th} Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.012	0.002***	-0.071	0.006***	0.050	0.012***	0.459	0.014***	0.754	0.011***
NYP	0.000	0.000***	0.003	0.000***	0.005	0.000***	0.004	0.000***	0.002	0.000***
AGE	0.000	0.000	0.000	0.000	-0.001	0.000**	-0.001	0.000***	0.000	0.000***
LEV	0.043	0.005***	0.388	0.019***	0.519	0.021***	0.286	0.019***	0.116	0.013***
AMAT	0.000	0.000**	0.006	0.001***	0.008	0.001***	0.005	0.001***	0.002	0.000***
MTB	-0.002	0.000***	-0.020	0.002***	-0.026	0.002***	-0.023	0.003***	-0.006	0.002**
R&D	-0.006	0.003**	-0.078	0.019***	-0.267	0.035***	-0.482	0.056***	-0.184	0.058***
ABNEARN	-0.001	0.001	-0.005	0.002**	-0.013	0.005***	-0.011	0.003***	-0.003	0.002*
VOLAT	0.011	0.007	0.031	0.027	-0.210	0.049***	-0.282	0.063***	-0.108	0.051**
ACCESS_L	0.344	0.014***	0.348	0.013***	0.185	0.010***	0.126	0.007***	0.065	0.005***
ACCESS_S	-0.026	0.018	-0.095	0.012***	-0.145	0.011***	-0.144	0.010***	-0.092	0.008***
CASH	0.000	0.004	-0.012	0.012	-0.025	0.033	0.192	0.029***	0.144	0.017***
TERM	0.000	0.000	-0.004	0.001***	-0.008	0.002***	-0.015	0.002***	-0.010	0.001***
CONSTRAINT	0.000	0.002	-0.003	0.006	-0.033	0.007***	-0.027	0.007***	-0.007	0.005
CONSTRAINT×VOLAT	-0.022	0.011**	-0.102	0.042**	0.014	0.068	-0.050	0.095	-0.073	0.091
CONSTRAINT×CASH	-0.003	0.004	0.037	0.018**	0.104	0.036***	0.068	0.045	0.043	0.022*
R^2	0.1945		0.2739		0.2963		0.2809		0.2479	

Table XIII (Continued)

Panel B: Debt maturity (DMAT) is calculated as the weighted average debt maturity structure of a firm's total debt based on the duration scheme of 0.3 years for debts payable in year 1, 1.3 years for debts payable in year 2, 2.3 years for debts payable in year 3, 3.3 years for debts payable in year 4, 4.3 years for debts payable in year 5, and 7 years for debts payable beyond year 5

	10^{th} Quantile		25^{th} Quantile		50^{th} Quantile		75^{th} Quantile		90^{th} Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	-0.073	0.041*	0.182	0.044***	1.003	0.060***	2.521	0.088***	4.241	0.091***
NYP	0.012	0.001***	0.020	0.001***	0.027	0.001***	0.025	0.001***	0.016	0.001***
AGE	0.002	0.002	0.001	0.001	-0.001	0.001	-0.003	0.002*	-0.003	0.001***
LEV	1.930	0.101***	2.530	0.100***	2.574	0.104***	1.944	0.129***	1.028	0.112***
AMAT	0.022	0.004***	0.041	0.005***	0.048	0.004***	0.040	0.006***	0.028	0.003***
MTB	-0.124	0.012***	-0.156	0.012***	-0.161	0.011***	-0.156	0.013***	-0.075	0.017***
R&D	-0.330	0.115***	-0.835	0.156***	-1.703	0.181***	-2.342	0.267***	-1.633	0.463***
ABNEARN	-0.048	0.012***	-0.058	0.011***	-0.070	0.023***	-0.082	0.020***	-0.060	0.018***
VOLAT	0.541	0.148***	-0.227	0.183	-0.970	0.275***	-1.397	0.411***	-0.500	0.414
ACCESS_L	1.312	0.066***	1.317	0.054***	1.107	0.053***	0.987	0.054***	0.842	0.046***
ACCESS_S	-0.246	0.094***	-0.468	0.075***	-0.624	0.065***	-0.754	0.074***	-0.773	0.064***
CASH	-0.245	0.101**	-0.361	0.099***	0.029	0.156	1.619	0.220***	2.100	0.161***
TERM	-0.015	0.007**	-0.021	0.008***	-0.039	0.010***	-0.054	0.012***	-0.054	0.013***
CONSTRAINT	-0.020	0.035	-0.066	0.037*	-0.166	0.039***	-0.133	0.049***	-0.040	0.048
CONSTRAINT×VOLAT	-0.856	0.250***	-0.609	0.281**	-0.359	0.396	-0.359	0.557	-1.260	0.725*
CONSTRAINT×CASH	0.235	0.103**	0.508	0.127***	0.468	0.185**	-0.095	0.317	-0.259	0.265
R^2	0.2975		0.3113		0.3168		0.3043		0.2527	

Panel C: Debt maturity (DMAT) is calculated as the weighted average debt maturity structure of a firm's total debt based on the duration scheme of 0.7 years for debts payable in year 1, 1.7 years for debts payable in year 2, 2.7 years for debts payable in year 3, 3.7 years for debts payable in year 4, 4.7 years for debts payable in year 5, and 13 years for debts payable beyond year 5

	10^{th} Quantile		25^{th} Quantile		50^{th} Quantile		75^{th} Quantile		90^{th} Quantile	
	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.	Est.	Std.Err.
Intercept	0.240	0.051***	0.331	0.061***	0.945	0.085***	3.231	0.179***	7.081	0.214***
NYP	0.014	0.001***	0.026	0.001***	0.041	0.001***	0.049	0.002***	0.034	0.003***
AGE	0.005	0.002***	0.005	0.002**	0.002	0.003	-0.006	0.003*	-0.007	0.003**
LEV	2.251	0.117***	3.329	0.138***	4.317	0.195***	4.125	0.276***	2.132	0.258***
AMAT	0.026	0.005***	0.058	0.008***	0.088	0.008***	0.084	0.013***	0.058	0.008***
MTB	-0.148	0.015***	-0.203	0.017***	-0.238	0.019***	-0.285	0.029***	-0.159	0.058***
R&D	-0.355	0.140**	-0.835	0.178***	-1.867	0.295***	-3.606	0.433***	-3.362	1.085***
ABNEARN	-0.052	0.015***	-0.070	0.022***	-0.122	0.038***	-0.155	0.043***	-0.146	0.045***
VOLAT	0.629	0.183***	0.072	0.257	-0.857	0.368**	-2.792	0.933***	-0.967	0.884
ACCESS_L	1.601	0.090***	2.323	0.104***	2.669	0.107***	2.272	0.121***	1.848	0.111***
ACCESS_S	0.056	0.158	-0.340	0.150**	-1.012	0.131***	-1.530	0.157***	-1.626	0.146***
CASH	-0.309	0.125**	-0.385	0.126***	0.080	0.220	3.225	0.473***	4.621	0.378***
TERM	-0.027	0.009***	-0.035	0.012***	-0.037	0.016**	-0.080	0.027***	-0.102	0.031***
CONSTRAINT	-0.023	0.042	-0.038	0.050	-0.189	0.067***	-0.234	0.105**	-0.126	0.108
CONSTRAINT×VOLAT	-1.011	0.321***	-0.934	0.367**	-0.406	0.523	-0.634	1.323	-3.528	1.558**
CONSTRAINT×CASH	0.299	0.132**	0.481	0.163***	0.557	0.271**	-0.445	0.668	-0.308	0.568
R^2	0.2724		0.2834		0.2915		0.2850		0.2352	

Figure I

Histogram of Debt Maturity Structure

This figure exhibits the debt maturity histogram. The weighted average debt maturity structure is calculated according to the Formula (1). The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010.

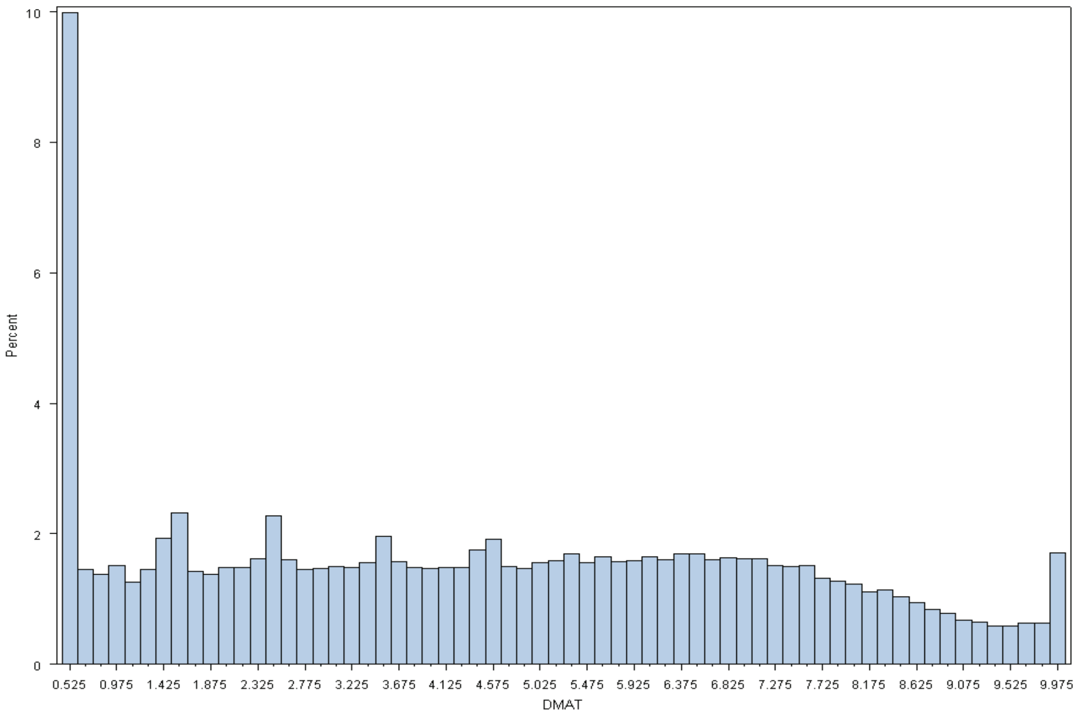
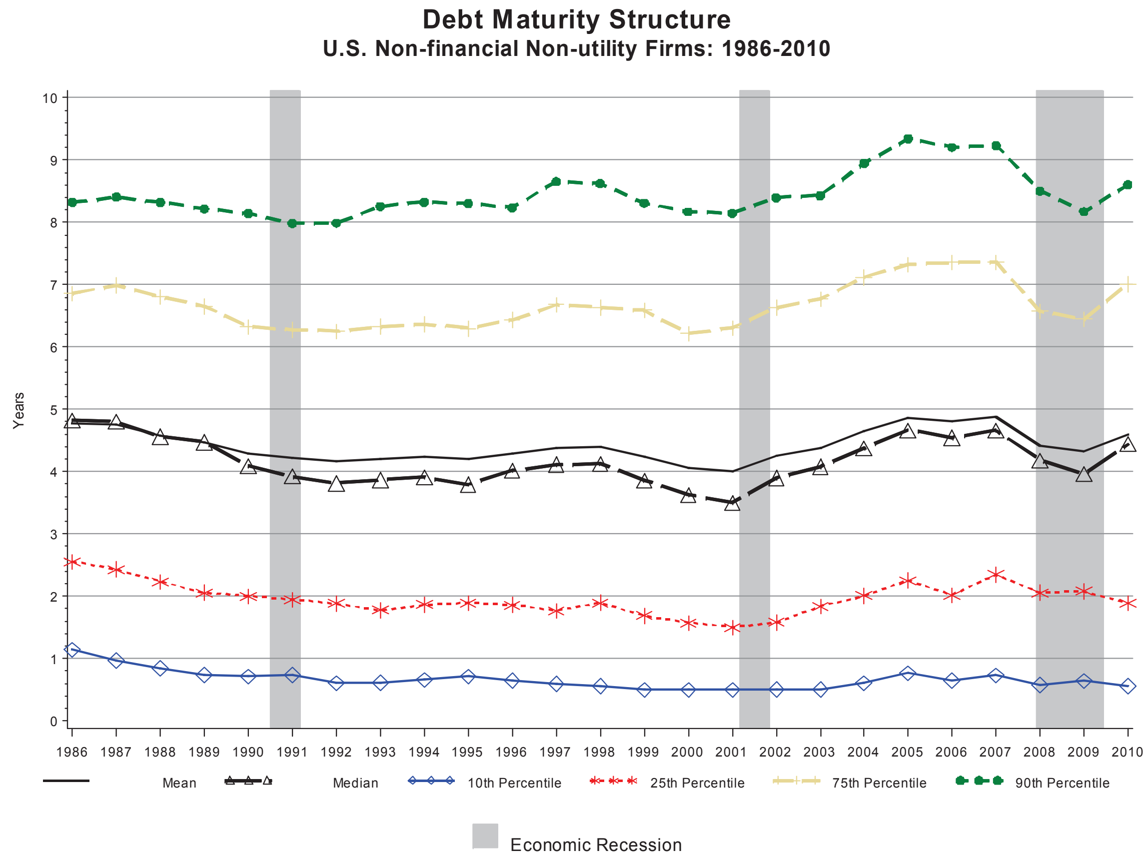


Figure II

Year-over-year Changes in Debt Maturity Structure

This figure exhibits the year-over-year distribution of the weighted average debt maturity structure from 1986 to 2010. The weighted average debt maturity structure is calculated according to the Formula (1). The over-time cross-sectional mean, median, 10th percentile, 25th percentile, 75th percentile and 90th percentile are displayed separately. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010.



Data Source: Compustat Industrial Annual Database, Federal Reserve Saint Louis Database

Figure III

Quantile Processes

This figure produces a total of 12 quantile processes for the covariates specified in the following empirical model. The sample consists of 7734 U.S. listed & based non-financial non-utility firms in the CRSP/Compustat Merged database over the period 1986-2010. The empirical model is specified as follows,

$$Q_\theta\left(DMAT_{i,t}\middle|X_{i,t-1}\right) = \alpha_\theta + \beta_{1\theta}NYP_{i,t-1} + \beta_{2\theta}AGE_{i,t-1} + \beta_{3\theta}LEV_{i,t-1} + \beta_{4\theta}AMAT_{i,t-1} + \beta_{5\theta}MTB_{i,t-1} + \beta_{6\theta}R\&D_{i,t-1} + \beta_{7\theta}ABNEARN_{i,t} + \beta_{8\theta}VOLAT_{i,t-1} + \beta_{9\theta}ACCESS\_L_{i,t-1} + \beta_{10\theta}ACCESS\_S_{i,t-1} + \beta_{11\theta}TERM_{i,t-1} + \beta_{12\theta}CASH_{i,t-1} + \beta_{13\theta}CONSTRAINT_{i,t-1} + \beta_{14\theta}CONSTRAINT \times VOLAT_{i,t-1} + \beta_{15\theta}CONSTRAINT \times CASH_{i,t-1} + \varepsilon_{i,t} \qquad i = 1, \ldots, n; t = 1, \ldots, T$$

The weighted average debt maturity structure is calculated according to the Formula (1). Other variables are defined in Table II and are winsorized at the 1st and 99th percentiles. For each covariate, we plot the quantile regression estimates as a function of quantile ranging from 0.05 to 0.95, shown as the pointwise solid curve. The shaded grey band depicts the conventional 90 percent confidence interval, estimated using the bootstrapping method. The long dashed line is the OLS estimate and the two dotted lines denote its confidential band.